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POWER

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Old Subscribers' Club

OCCASIONALLY, a subscriber, when writing in, will remark that he has been reading *Power* for twenty years or thirty years or since it was a blanket-sheet monthly.

I meet sometimes at gatherings or at their plants veterans who tell me how long they have known me through *Power*.

One of them began to read it when it was yet *Steam*; and that was before I became its editor nearly forty years ago.

It is a pleasure to know of these faithful ones with whom we have been, in a manner, associated so long.

I have seen many of them arise from small beginnings to positions of large responsibility and comfortable remuneration.

Some of them I can call by name; with some I exchange occasional greetings. But I suppose there are many of whom I have no personal knowledge.

"The headstones thicken along the way." Many of the old timers have rung in their last checks or signed their last reports.

There is an urge to huddle together in a diminishing herd. The engineers of two-score years ago have things in common that the newer generation wots not of.

Write in, some of you who have been reading *Power* since the beginning of the 1900's or before, not necessarily for publication, although many of you could tell stories that would make the newer subscribers sit up and take notice, but as to a convocation of the veterans.

We may have among us the making of an enjoyable association.

F. R. Low

Federal Investigations and the Public Interest

ADJOURNMENT of the Federal Trade Commission's investigation of the public utilities industry which occurred on July 6, when a recess until September was taken, served to focus again the whole question of governmental inquiries. In certain quarters these sessions are greatly commended, while in others they are as bitterly denounced.

In the case of the utilities the investigation will serve one good end that is not apparent on the face of things. Due to one thing and another, a definite body of opinion unfavorable to the utility industry had grown up in certain quarters. To combat this, the utilities had resorted to a campaign of propaganda which did not always serve its purpose, in fact, in some cases definitely strengthened opposition.

Now, all this will be brought out into the light by the commission. The result should be a distinct clearing of the air. The industry will learn to carry on its publicity work in ways less open to misinterpretation. And at least some of those who now condemn will realize that underneath what have often appeared to be suspicious acts is a great industry, essentially sound, that fills a necessary place in the modern scheme of things.

From this aspect of the public utility investigation it can be argued that federal inquiries are needed and helpful, at least in certain fields. And this is so, for they bring the truth into the open where it can be seen, and they cut the props from under the demagogue and the selfish agitator.

Has Doctor Diesel's Dream Come True?

THE oil engine as patented by Doctor Diesel was merely a concession to difficulties facing him in the attempt to design an engine to burn coal dust within its cylinder.

Since that early dream of the eminent German engineer, many have thought of and a few essayed an attempt to burn pulverized coal. Most of these efforts have been in the laboratory and have resulted in nothing of practical value, although it was proved that finely ground carboniferous materials could be ignited. The problem goes beyond mere ignition and includes completeness of combustion, erosion from the fused ash, lubrication difficulties and a score of others, each of which has been of sufficient difficulty to dampen the enthusiasm of most investigators.

It is to the credit of Mr. Pawlikowski that he set to work with determination to overcome these apparently insurmountable obstacles. His labors have resulted in an engine which, by all reports, is able to burn pulverized coal in a satisfactory manner.

He has found that while fineness of grinding is important, the fuel need not be an impalpable powder. The erosion turns out to be mostly imaginary, for by proper turbulence, brought about by air jets along the cylinder barrel, the ash never settles on the iron surface, but passes out with the burned gases. Nevertheless, engineers will insist, and quite properly so, that the absence of erosion be definitely proved by rigid investigation.

The claim of a smoke-free exhaust requires substantiation by non-interested parties. Without questioning the designer's statements, it must be established that the exhaust will remain clear. It seems that with the pulverizing commercially possible, some of the particles must leave in a partly burned condition. Furthermore, the correct air-to-fuel ratio must be more difficult to obtain than in an oil engine.

If the coal-dust engine equals the claims made, there is opened a wide field of application in those districts where oil is high, and coal is cheap but still too expensive to justify its use in a non-condensing steam plant.

They Tried It and It Worked

WEAR of the exhauster fan has always been a serious difficulty in the air-swept pulverizing mill, owing to the fact that plants have formerly been designed so that all the pulverized material must pass through the fan. Some time ago somebody suggested that the cyclone separator be placed between the mill and the fan, but all the wise ones said that it couldn't be done. It wouldn't work at all.

But somebody tried it. We believe that the initial experiment was made by F. H. Rosencrants, in England, and it is interesting to note that in a recent paper that he read before the Institution of Electrical Engineers in London, he shows an illustration of the system in which all the material passes through the fan, labeled "Obsolete system of mill piping." An illustration of the arrangement shown by Mr. Anderson on another page of this issue, is labeled by Mr. Rosencrants "Up-to-date system of mill piping." It would appear that in England this arrangement has become better known than on this side of the water.

It is difficult to guess why this plan was not tried long ago, but the fact remains that it was not, despite the struggles of many men of high competence to overcome the difficulty of fan wear. Just another case, perhaps, of unwillingness to try something that everybody knows cannot be done.

At any rate the thing has been done now, and *Power* is glad to have the opportunity to report Mr. Anderson's experience with what is believed to be the first application in America of this simple solution.

Testing Is Not Research

TESTING is a highly commendable activity, but it is not research and should not be paraded under that name.

So great have been the contributions of research to prosperity that everybody is now climbing on the band wagon. Those that cannot afford the real thing — or think they cannot—are pulling down the signs over the doors of their testing laboratories and putting up new shingles with the magic word "Research."

While this activity must be flattering to the men who have labored these many years to convince the world that science begets dollars, it has its dangers. The grist of the testing-laboratory mill can be baked into the nourishing corn bread of industry, but it won't do for angel cake. Yet some will try the latter and blame the culinary failure on the research enthusiastics. Testing has its undisputed place in modern industry. But call it by its right name.

Imagine the Savings!

IMAGINE what a difference it would make in the steam consumption of some industrial plants if the steam for building heat were applied as economically as the steam for prime movers. Too many, unfortunately, tend to neglect the heating system and to disregard the savings that could be made there. Uncovered pipes, leaks, incorrect use of radiating surface and numerous other heating system faults are frequently the cause of much loss.

The plant operating force should not be expected, however, to prevent these troubles. Their business is production and they can serve best by sticking to it. The power engineer is the one man in the plant who understands how to apply steam economically, and he is the logical overseer of the heating facilities.

Unfortunately, some managements do not yet realize this. Most are aware of it and long ago made the power engineer responsible for plant heat. When the backward ones wake up and follow suit, imagine the savings that will be made!

Uniform Specifications For Diesel Fuel

AS IS outlined on another page by G. H. Michler, the oil marketing companies are vitally interested in the creation of standard Diesel fuel specifications.

While the oil companies' motives may be primarily selfish, yet both the oil-engine builder and user would benefit if it were possible to purchase a fuel that would permit the engine to function properly and still be so constituted as to avoid unnecessarily high fuel costs.

Apparently, the difficult item is that of sulphur content, for it is the holding of this down to less than one per cent that makes oil expensive.

There is no unanimity of opinion as to how much sulphur can be permitted or as to the variation in behavior of engines of different types. Two makes of air-injection Diesels may carry entirely different recommendations, while builders of solid-injection engines of identical characteristics show no agreement.

This evidence indicates that there are no basic reasons for the variations in the permissible sulphur content. No researcher has found that the limiting values and apparently the idiosyncrasies of the sales engineering departments are given full swing.

The old idea that sulphur destroyed cylinder liners and valves does not hold true if a sulphur-free oil is used for a few minutes before shutting down. With this simple precaution, even cast-iron exhaust lines will last indefinitely.

Engines have operated and now operate on oil with two to five per cent sulphur, without any noticeable increase in the maintenance. In the average plant as much as two per cent can be permitted. This means a marked reduction in fuel costs and for a management to continue to buy the more expensive fuel is a sheer waste of company funds.

The American Society of Mechanical Engineers, through the Oil and Gas Power Division, is preparing to examine the whole subject of fuel-oil specifications. The newly organized Diesel Society can do much to promote this movement, representing, as it does, the engine builders. But the subject must be approached with due appreciation of the many difficult situations to be overcome. Certainly, an engine builder will not agree that his engine will not burn any oil that can be used by his competitor. At the same time, it is but natural for him to recommend the use of a high-grade fuel, for obviously the better the oil the lower will be the maintenance charges.

The problem can be solved if all concerned will adopt a reasonable give and take attitude and agree to consider the matter on its merits.

The Greatest Benefit to the Largest Number

NIAGARA FALLS has been of interest to the white man for nearly four hundred years. At first this interest was as a natural wonder, but later it attracted attention for both its scenic beauty and power-generation possibilities. Today satisfying these two interests involve problems of tremendous importance as evidenced at the recent convention of the American Society of Civil Engineers and reported elsewhere in this issue.

For the last twenty-five years much attention has been given to what should be the final utilization of Niagara Falls. On one side is the ultra-conservationist who would have the Falls used as a natural spectacle only. Opposed to this school is the strict utilitarian, whose chief interest lies in how the Falls may be utilized for power production only. Between these two extreme schools is a third whose members believe that the scenery of Niagara can be preserved and, at the same time, that a substantial part of the water can be used for power purposes.

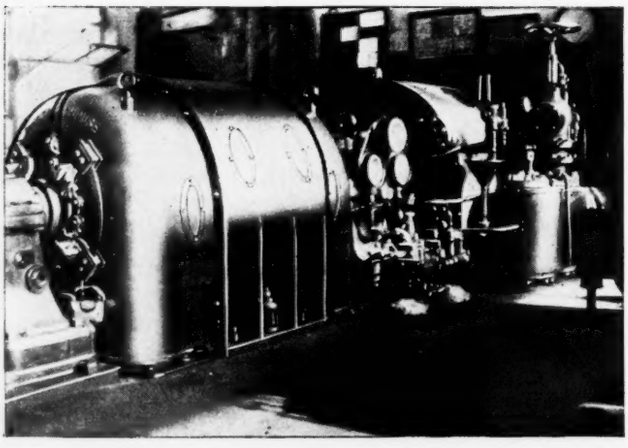
This middle school's position is pretty well proved to be the correct one by past experience. In 1927 the power plants on the two sides of the river produced six and three-quarter billion kilowatt-hours. Even when generating this large amount of power, which was equal to about ten per cent of that generated by central stations in the United States during the same year, the Falls were just as beautiful as if all the water passed over them.

On the basis of one and one-half pounds of coal per kilowatt-hour this power is the equivalent of five-million tons yearly. This figure is more significant when it is considered that in Ontario industrial development depends largely on water power, since when fuel is used it must be imported and transported long distances; therefore it must necessarily be high in cost.

The special Niagara Board appointed by the governments of the United States and Canada has recently submitted an interim report in which it recommends the construction of certain remedial works to obtain better distribution of the water over the Falls, to decrease the erosion in the Horseshoe of the Canadian cataract and to test the effects of further diversion for power development.

The recommendation can be carried out at a comparatively low cost and tested before any permanent diversion is allowed, therefore there should be no objection to putting the board's recommendations into effect. Niagara Falls is one of the world's greatest scenic spectacles and water powers. A proper balance between these two features will benefit the greatest number, and this should be the final development. Fortunately, such a program can be carried out by a careful cut-and-try procedure.

High Back Pressure Turbine



The turbine that made the improvement

Aids Power Service Economy

In Rubber Manufacture

By Warren P. Smith

Maintenance Engineer, Seamless Rubber Company, New Haven, Conn.

THE plant of the Seamless Rubber Company, at New Haven, Conn., was finished and put in operation in 1920. It is close by the railroad yards, with a convenient siding into the plant. Although the plant is on the shores of New Haven Harbor, there is no channel to it and no steam condensers are used.

The main building consists of three parallel five-story buildings with two one-story glass-roofed buildings between Nos. 1 and 3 and Nos. 3 and 5, a small one-story building housing departments using inflammable materials, and the power plant.

Some of the products of the plant are water bottles, face bags, bathing caps, rubber tubing, hard rubber pipes, hard rubber combs, play balls, bulbs, syringes, rubber wheels and castors, toilet seats, rubber gloves, football bladders and adhesive plaster.

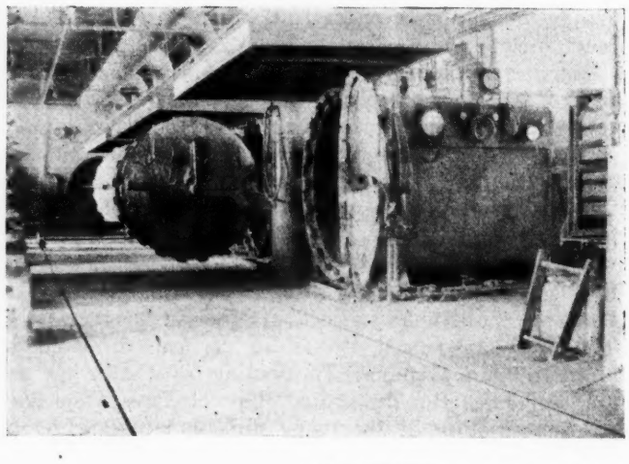
In the process of milling the rubber and compounds, a great deal of water is required for cooling the rolls. Some water is also used in cooling molds after the rubber has been cured with steam. The power plant must furnish steam for heating molds, and for curing goods in vulcanizers, compressed air for controls on vulcanizers, operating forming presses, and for cleaning molds, and hydraulic pressure for operating the hydraulic presses. About three-quarters of the electric power is purchased from the local power company; the rest is generated at the plant by a high back-pressure turbine.

The power plant that furnishes this service was originally equipped for generating all steam for the process and auxiliaries, but all electricity was purchased. Four 3,930 sq.ft. Babcock & Wilcox boilers with superheaters and designed to operate at 200 lb. pressure with 100 deg. F. superheat are installed in the boiler room. These are equipped with Combustion Engineering Type "E" stokers and Richardson automatic coal scales. The feedwater line is a loop system designed to make possible the isolation of any section for repairs. The feed water is heated with exhaust steam from the auxiliaries in a Cochrane metering heater and flows to the feed pumps in the basement of the boiler house.

All coal is brought to the plant by rail. When possible, this is dropped from the cars into a track hopper, is crushed in a pit below and then elevated to the overhead bunkers by a fixed bucket-type conveyor. A belt conveyor with unloader distributes the coal along the bunker. The excess coal is transferred from the cars to a storage pile with an electrically driven stiff-leg derrick. Ashes are dropped from the ash hoppers into cars wheeled to a pit in the yard and later removed from the plant by truck.

Two Worthington-Jeanesville three-stage centrifugal pumps of 180 g.p.m. capacity, driven by Westinghouse re-entry wheel turbines, handle the feed water. These are controlled by Fisher governors, keeping the pressure

Vulcanizers such as this are large consumers of process steam



in the feed line constant. The level of water in the boilers is maintained by Stets feed-water regulators.

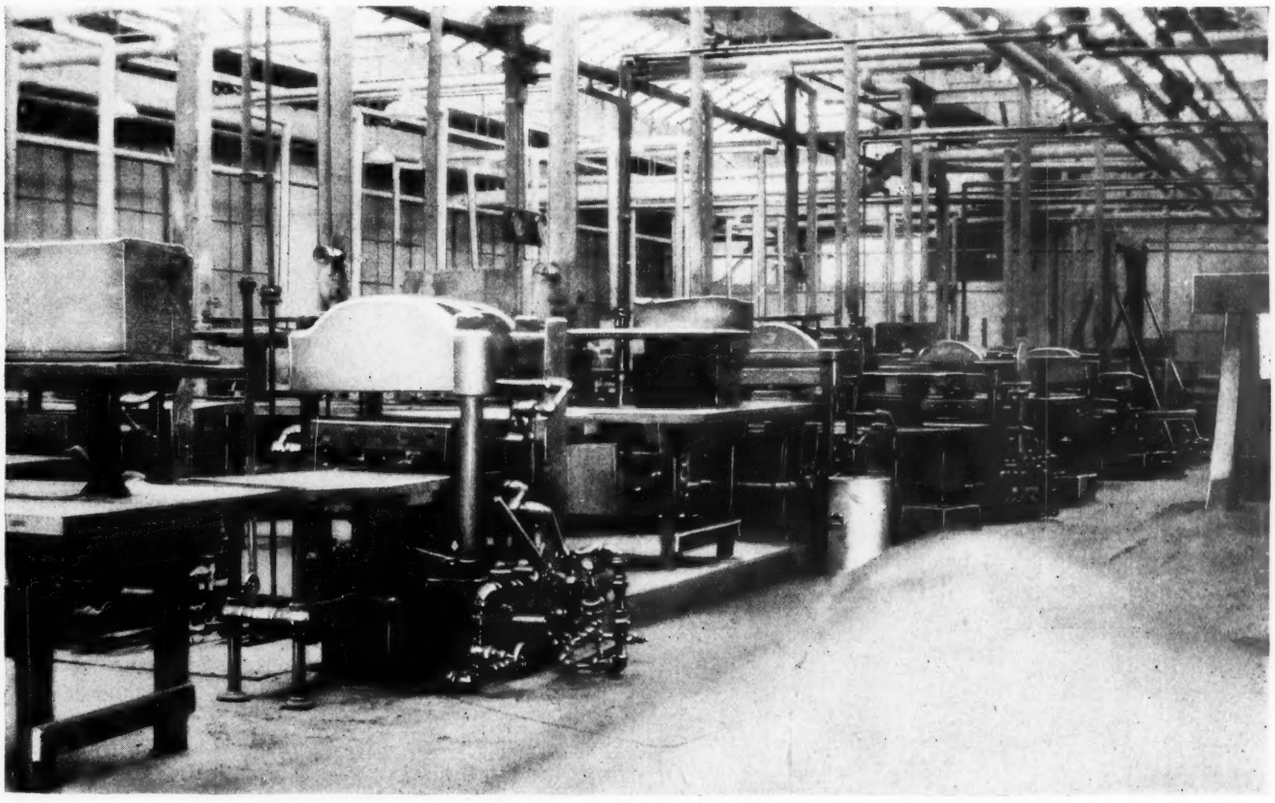
The air for combustion is supplied by either of two No. 6½ Buffalo Forge Company turbo-conoidal fans of 40,000 cu.ft. capacity at 6 in. static pressure, one driven by a variable-speed motor and the other by a Westinghouse mechanical-drive turbine similar to the feed-pump turbines. This combination makes possible an approach to a heat balance by operating the motor-driven fan during the week when there is an excess of exhaust steam and operating the steam-driven unit over week-ends when there is a deficiency of exhaust steam for heating the feed water and the buildings during the winter months.

Service water for the factory is pumped from a tank under the pumproom floor to an elevated tank in the yard. Duplicate motor-driven single-stage centrifugal pumps of 600 g.p.m. capacity are installed for this service. The elevated tank has a capacity of 100,000 gal., one-quarter of this being available for service water and the rest piped to the sprinkler system and arranged so that this 75,000 gal. cannot be used for service water. A steam-driven duplex double-acting fire pump is also installed.

In two departments colder water is required for cooling mill rolls and molds. Three wells were sunk in the yard and equipped with air lifts. This water is raised to a settling tank in the pumproom, and a small motor-driven single stage centrifugal pump supplies these departments. A float-controlled valve on a city water line takes care of the fluctuation in the quantity required.

The requirements of hydraulic pressure for molded goods consists of 600 lb. per sq.in. pressure for operating 87 presses in one room and 1,800 lb. per sq.in. pressure for operating 20 presses in another room. This service is furnished by steam-driven pumps in the power house with their accumulators. The 600-lb. pressure pump is a 16x3½x12-in. duplex double-acting outside-packed plunger pump of about 75 g.p.m. capacity controlled by a chronometer valve from the accumulator. There are also two motor-driven triplex power pumps, each of 28 g.p.m. capacity for the same service. These are driven by constant-speed motors which keep the accumulator moving up and down owing to the constant starting and stopping. The steam pump gives much steadier operation because of the constant follow-up action of the control, which allows the accumulator to move only a short distance.

The pump furnishing the 1,800-lb. service is a 14x2¼x12-in. duplex double-acting outside-packed plunger pump controlled in the same way as the 600-lb. pump.



Hydraulic press room, the heart of a molded rubber manufacturing plant

Compressed air for wells is furnished by two motor-driven Allis-Chalmers two-cylinder compressors each having a capacity of 50 cu.ft. of free air per minute.

All other compressed-air service is supplied during the week by a 16x10½x16x16-in. steam-driven two-stage Norwalk compressor of 550 cu.ft. free air per minute piston displacement when operating at 150 r.p.m. and over week-ends or for breakdown service by a motor-driven single-stage 12x10-in. Sullivan compressor of 307 cu.ft. displacement. This compressor is also piped by separate line to ball forming presses which require approximately 90 lb. per sq.in. to cut the stock successfully and is operated at such times as the main line pressure is reduced.

In the turbine and switchboard room two 520-hp. synchronous motors driving direct-current generators

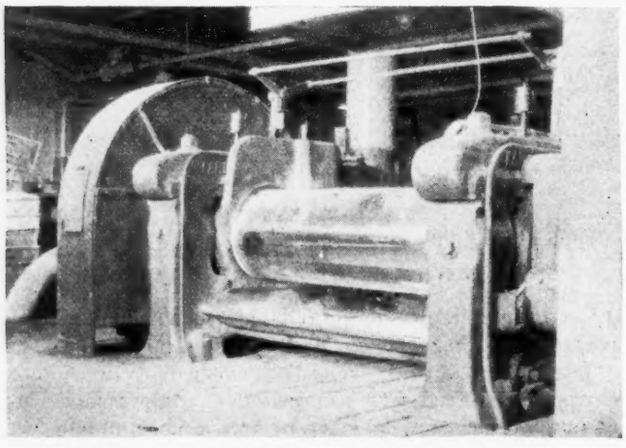
furnish the current for variable-speed motors on the forced-draft fan, the calendar drives, brakes and clutches and any other small uses of direct current. At times one of these is operated without load as a synchronous condenser, decreasing the current on the incoming lines and increasing the power factor.

Addition to Equipment in 1926

An interesting addition was made in 1926 to the power equipment. This is a Westinghouse high back-pressure turbine driving an alternator designed to operate on steam at 190 lb. per sq.in. and 100 deg. superheat at the inlet and 90 lb. per sq.in. at the exhaust. This 90-lb. steam is then supplied to the factory and the auxiliaries. The turbine was originally supplied with a nozzle to pass 40,000 lb. of steam per hour. This nozzle was replaced after about five months' operation by one to pass a maximum of 26,000 lb. of steam per hour. This change was made because the steam requirements of the factory were less than 40,000 lb. per hour at that time. However, when the present nozzle will not pass as much steam as is necessary to supply the factory, the excess passes through a reducing valve which is controlled by a Ruggles-Klingerman regulator. The generator driven by the turbine is rated at 375 kva. at 80 per cent power factor, but this is over the 220 kw. capacity of the nozzle in the turbine.

In order to iron out the fluctuations of load on the turbine, a 75-kw. alternator driven by a 108-hp. synchronous motor is operated in parallel with the turbine-alternator during the week. Over week-ends this motor generator set carries all the lighting circuits and all other electric power is carried at that time on the incoming lines of the local power company. The turbine is not operated on Saturdays and Sundays because of the low steam load.

In order to generate as much power as possible on the turbine, a duplicate set of buses is provided. The combination of circuits carried on the turbine is changed from time to time in order to balance the turbine load and the steam requirements and at the same time load the turbine to as near full capacity as possible.

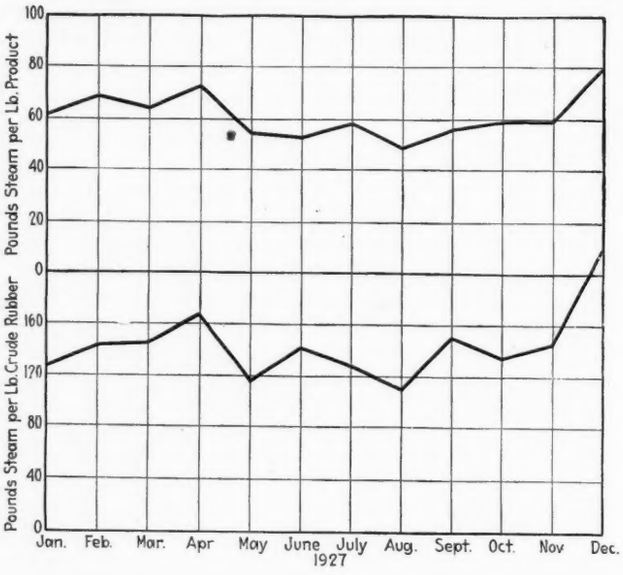


One of the rubber mills, a big consumer of electric power

The amount of electricity purchased amounts to from 250,000 to 300,000 kw.-hr. per month and the power generated by the turbine about 70,000 to 85,000 kw.-hr. per month. The amount of steam generated and used either in the process or to operate the auxiliaries is about 20,000,000 lb. per month. We have no accurate way of determining how much of this is used for driving the auxiliaries.

The mixture of well water and city water used in certain departments for cooling is metered. This service varied considerably for the last three months of 1927, running from 121,000 to 207,000 cu.ft. per month.

The amount of service water is not metered, most of it returning to a tank in the power house and used over again. The amount of city water used per month, which includes the makeup for the well-water system, makeup for boiler-feed water and the drinking-water system is about 1,000,000 cu.ft.



Curves showing relation of steam used to the raw material consumed and the product turned out

How Power Service Application Varies

The application of each power service varies considerably. The hydraulic pressure is applied in hydraulic presses which squeeze some rubber compound into the cavities of a mold and hold it there during the time of curing. The steam used in curing is applied to the head or platens of the press and heat is transferred to the mold by conduction.

In some cases the stock is heated for a certain length of time with steam as previously described and then cooled with water. For this service the press or mold must have steam and water inlets and steam and water returns. These, with one exception, are returned to the power house to be used again.

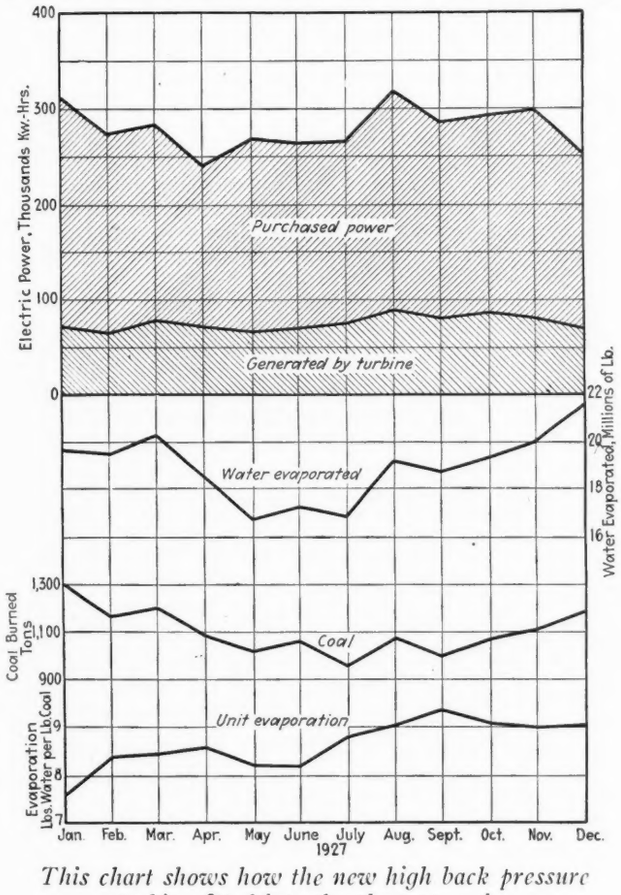
The steam used in vulcanizers may be applied indirectly in those vulcanizers that have jackets by keeping the jackets filled with steam, or in some cases the steam is admitted to the inside of the vulcanizer with the product. Some products are also cured in dry heaters, which are insulated boxes heated with steam coils under a grating floor and arranged so that a circulation of hot air will come in contact with the goods.

The uses of compressed air are also varied. Besides the common practice of cleaning motors and other equipment, it is used in a sand-blast machine for cleaning molds. Another application, where pressure is the requisite rather than velocity, is in operating the ball forming presses previously mentioned. Some air is also used in testing for leaks in such products as football bladders.

The control of steam is interesting in such cases as the vulcanizers and dry heaters. It is necessary to control not only the temperature but the time of cure as well. For these a Tagliabue time-temperature controller is installed.

Electric Power Service as Applied to Acid-Cure Tumbling Barrels

One interesting application of electric power service is in the drive of a battery of acid-cure tumbling barrels. These barrels are driven from a lineshaft with tight and loose pulleys or clutch cutouts. The stocks cured in the barrels are thin-gage rubber, which must be kept in motion until the critical point of the cure is passed. The lineshaft was driven by a 5-hp. motor, taking its current from a feeder on the main switchboard which was carried part of the time on the turbine and the rest of the time on the incoming lines. Whenever this feeder was changed over, the no-voltage release cut out the motor and the barrels stopped. Unless the operator was handy to throw out the clutches and then start, the stock would



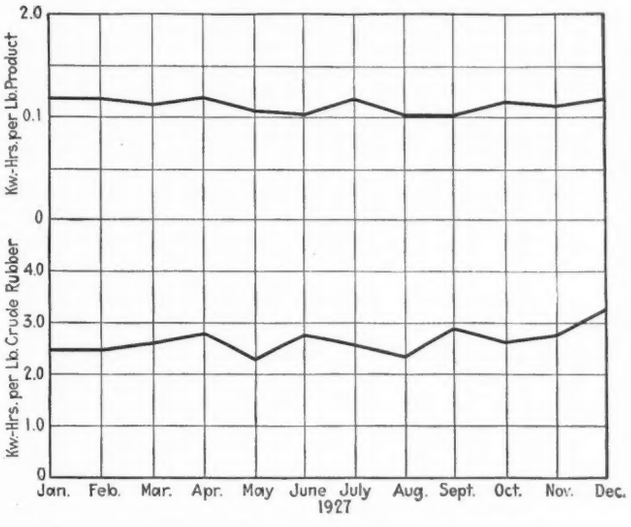
This chart shows how the new high back pressure turbine fitted into the plant operation

settle to the bottom of the barrel and creases would be cured in it.

Another 5-hp. motor was connected to the same shafting with leads from a feeder which is always carried on the incoming line. Both motors are operated, each taking half the load. If one motor kicks out for any reason, the other one, being on a separate feeder, will pick up the total load and the barrels do not stop.

The usual operating week is 5½ days of 9½ hours each, with a few departments, such as the mill room and press-work, working nights to balance the production with the equipment for producing. When any department is making a change in their working schedule, the foreman of that department is expected to send an order to the power house stating what service will be required and for what length of time. From the assembly of these orders the chief operating engineer can tell what equipment must be operated for the required extra service.

An idea of the amount of steam and electric power



Curves showing relation of electric power to raw material consumed and product made

used during 1927 can be had from the graph of these which shows the variation month by month. This also shows the amount of electric power generated by the high back-pressure turbine.

What's the Boiler Efficiency?

While the steam-heating plants in use in the habitations of man are a comparatively modern invention, the Department of the Interior points out that nature has a steam-heating system of her own that has been in operation for many centuries and which has recently been put into practical use in some of the government national parks. In the Yellowstone, a store, a hothouse and a bathhouse are now being kept warm through the use of natural hot-water heat.

In the Hawaii National Park, in the Hawaiian Islands, the administration building of the National Park Service is heated by live steam piped from one of the hot vents of the Kilauea Volcano.

Another area where natural heat may be used for heating and even cooking purposes is the Valley of Ten Thousand Smokes, in the Katmai National Monument, Alaska. This area is inaccessible to the public generally, but exploring parties have reported that during cold weather their tents could be so placed that they were heated by steam from one of the "ten thousand smokes" that rise all over the valley, and that in some of the vents food could be cooked.

Fan on Collector Discharge

Cuts Pulverizing Costs

By John Anderson

Vice-President in Charge of Power
The Milwaukee Electric Railway & Light Company

FREQUENT renewal of mill exhauster blades at the Lakeside Station of The Milwaukee Electric Railway & Light Company caused investigation of the possible placing of the fan so that the coal would be separated out before the air reached the fan. On the most recent Raymond pulverizing mill installation, the mill exhauster fan is placed on the return side of the cyclone collector. The fan thus handles practically no coal, and the advantages of this are apparent.

The points of superiority of this layout over one in which the fan discharges into the collector are:

1. Less fan power consumption because the fan wheel does not accelerate coal, and because a more efficient fan can be used.
2. Less maintenance owing to no wear on fan.
3. More compact installation at lower cost.
4. Suction system gives a cleaner mill room.

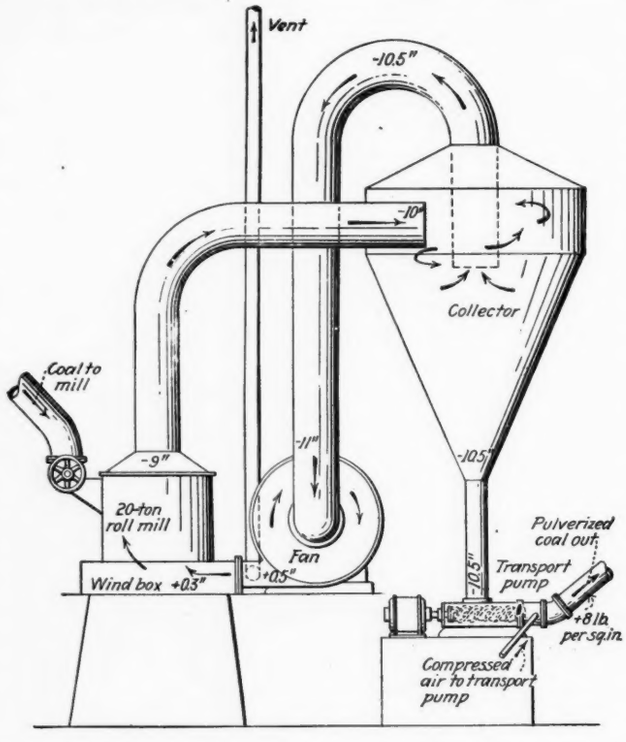
The fan tip speed in this and in a similar installation is 15,800 ft. per min. Where the fan handles coal direct from the mill, the energy required to accelerate a ton of coal to fan speed is slightly over one horsepower - hour. Fan - power readings on two identical mills, one with the fan discharging into the cyclone and the other with the fan on the cyclone discharge, show an actual reduction of one kilowatt-hour per ton for the latter.

When the fan is not handling coal, it is possible to get away from the present steel-plate paddlewheel type and use a more efficient fan of the shrouded multivane type.

With the usual system of an exhauster fan pulling coal and air directly from the mill, a principal item of maintenance is renewal of fan blades due to erosion by the pulverized coal. Many special blade materials have been tried, including stellite, glass, hardened carbon steel, and rubber covering. However, most users seem to find it the most economical to use boiler-plate blades and renew them when necessary.

After the mill had ground 40,000 tons of coal and been in service slightly over 2,200 hours, the fan blades on this most recent installation showed practically no wear. Very small tool marks are still visible, and appearances indicate an indefinite life for the blades. Evidence shows, in pulverizing-mill installations handling various materials, that wear on fans is caused by material coarser than 200-mesh. Coal in the return air from the collector is all finer than this.

Less room is required in the new arrangement than where the fan is above the mill. It will be possible to make future installations even more compact by putting the fan on the floor next to the mill motor, and lowering the collector until the transport pump is on the floor. This saves building space and structural steel for supports.



Inspection of the diagram shows that nearly all parts of the system are under a suction. Leakage is thus inward, and the greatest source of dust in the mill room is eliminated.

The diagram shows that the entire collector is under a suction of about ten inches of water, and that therefore a seal of some sort is necessary at the pulverized-coal discharge. In this installation the purpose is satisfactorily served by a transport pump. A feeder screw would accomplish this also, where the collector discharges directly into a feeder bin. Where discharge into an open bin is desired, a mechanical baffling device could be used.

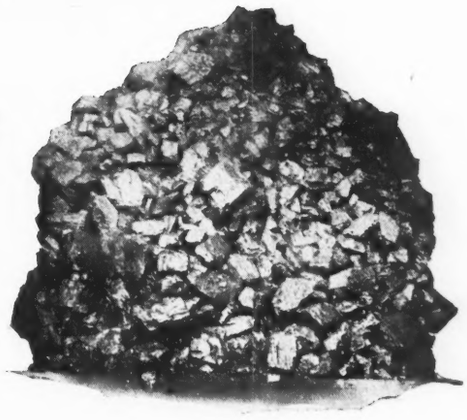
Coal dust does not get into the mill gearing with the windbox pressure less than one inch.

Although nearly the entire system is under a suction, leakage is much less than that in previous pressure-system installations. Vented air in the new system is only 2 per cent of that circulating, whereas in previous mills the usual figure is 5 per cent.

An additional advantage, though of small moment, is improved separation of the coal and air in the collector. The air in the new collector, being under 10 in. suction, is 4 per cent less dense than in the older collectors under 4 in. pressure.

The change in fan location has not affected air flow, fineness nor mill power consumption. This design seems usable in all installations where the collector can discharge into a closed receiver or sealed conveyor. Usually, this is the situation.

How Composition Affects Burning Qualities of Coal



By A. A. Potter and H. L. Solberg

Dean of Engineering, Purdue University

Ass't Prof. of Mechanical Engineering, Purdue University

The influences of moisture, oxygen, sulphur, nitrogen, as well as clinkering properties, discussed from the operating viewpoint.—*Editor*

MOISTURE is objectionable in coal for several reasons: In the first place, being inert, it dilutes the fuel and the cost of shipping high-moisture coals for considerable distances is prohibitive. Secondly, the heat required to evaporate the moisture and superheat it to the temperature of the chimney gases decreases the "available" or "net" heating value of the coal to less than that determined by the calorimeter. Ten per cent of moisture reduces the effective heating value of fuel nearly 12 per cent. The effect of moisture upon the heating value and efficiency of a boiler is shown in Fig. 1.

Moisture in considerable quantities reduces the furnace temperature and decreases the rate of combustion. Fuels will not burn until the moisture has been evaporated and the combustible heated to at least 800 deg. F. Absorption by the moisture of the heat required for its evaporation reduces the furnace temperature, which in turn slows down the rate of heating of the fresh coal. Since the effect is cumulative, the combustion of high-moisture coals can best be effected by specially designed furnaces that maintain a high furnace temperature and by unusually large grates which will compensate for the slow rate of combustion.

High-moisture coals, such as are found throughout the western part of the United States, lose much of their moisture on exposure to the atmosphere and quickly slack or crumble and disintegrate. This, together with the excessive cost of transporting high-moisture coal, has made it impracticable to utilize the enormous deposits of low-grade coal situated in regions far removed from deposits of high-grade coal.

Nitrogen as a Byproduct

Nitrogen is present in coal in small amounts, varying from 0.75 to 1.75 per cent, with an average of about 1.25 per cent. It is inert and harmless when the raw coal is used as a fuel. It is of considerable importance in the manufacture of prepared fuels from coal, as the ammonium sulphate recoverable through byproduct processes depends upon the nitrogen content of the fuel.

The principal change that has occurred during the transformation of peat into coal has been a gradual loss of oxygen, the better grades of coal having the lowest oxygen content. After making a study of more than 300 representative coals, White[1] came to the conclusion that oxygen and ash have the same effect on heating value. He obtained the curve shown in Fig. 2, when the heating value of the fuel was plotted against the ratio $\frac{\text{Total Carbon}}{\text{Oxygen} + \text{Ash}}$. The equation for this curve for either wet or dry coal, is[2]

$$\text{Heating value} = 16{,}780 - \frac{17{,}230}{r + 0.98}$$

where $r = \dfrac{\text{Total Carbon}}{\text{Oxygen} + \text{Ash}}$

The oxygen is combined chemically with carbon and hydrogen in the fuel, thus rendering a part of the carbon and hydrogen incombustible or inert.

Volatile as a Producer of Smoke

Volatile matter consists of those compounds that are gasified and driven from the fuel by heating it to 1,750 deg. F. in the absence of oxygen. The volatile matter in anthracite is principally methane (CH_4); in bituminous coals, it includes many heavy hydrocarbons and tars, and, in lignite and low-grade fuels, is diluted by large quantities of non-combustible gases. From 60 to 90 per cent of the volatile matter consists of combustible gases which may represent as high as 60 per cent of the total heating value of a coal. Since these gases must be burned after they are distilled in the fuel bed and before they strike the relatively cold boiler tubes, it follows that the percentage of volatile matter has an important bearing on furnace design and the distance from the grate to the boiler tubes.

Visible smoke is due to the decomposition of the volatile matter into carbon particles and less complex gases, the soot thus formed producing the black color in the chimney gases. Low-volatile coals like anthracite can be burned in any kind of setting without producing smoke, while the high-volatile coals require a large combustion chamber and even then will produce smoke unless properly fired. Not only the quantity but the quality of the volatile matter has an important bearing on the ease with which coal can be burned without smoke. In general, the greater the carbon content of the hydrocarbon gases the more pronounced will be the tendency

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[1]Bureau of Mines Bulletin 29.

[2]Haslam and Russell, "Fuels and Their Combustion."

to produce smoke. The ratio of volatile carbon (total carbon — fixed carbon) to available or combustible hydrogen $\left(\text{total hydrogen} - \frac{\text{total oxygen}}{8}\right)$ may be taken as an index of the smoke-producing tendencies. If two coals have the same percentage of volatile, that in which this ratio is the larger will be the more difficult one to burn without producing objectionable smoke.

Sulphur Objectionable

Sulphur is an objectionable impurity which may be present in amounts varying from 0.5 to 6 or even 7 per cent. Chemically uncombined sulphur has a heating value of about 4,000 B.t.u. per lb., but over half of the sulphur may be combined in such a way as to be inert. Sulphur is found in coal mainly as iron pyrites (FeS_2) and as calcium sulphate or gypsum ($CaS_4 \cdot 2H_2O$), although some of the sulphur may be present in organic compounds. Iron pyrites, or "fool's gold," is particularly objectionable. It is distributed as bands parallel with the bedding, as small veins across the seam or in lumps of considerable size. When present in sufficiently large pieces, it is often separated from the coal during mining and is sold for the manufacture of sulphuric acid.

When coal is stored in the open and is exposed to rain

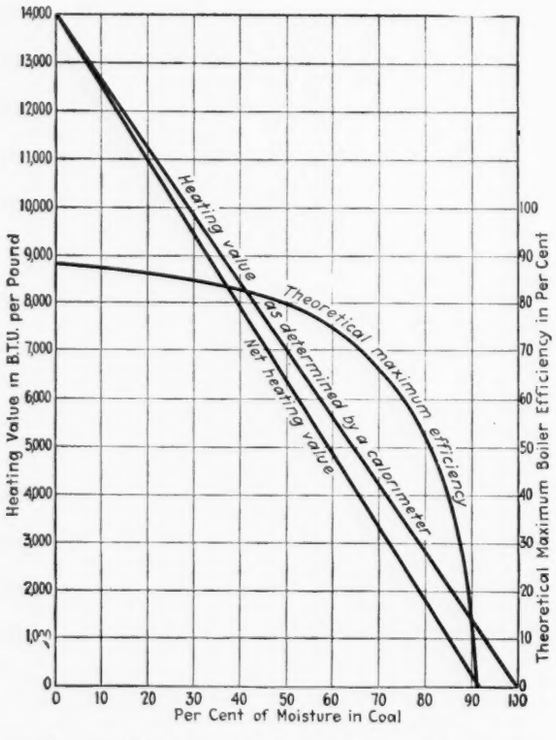

Heating Value in B.T.U. per Pound
Theoretical Maximum Boiler Efficiency in Per Cent
Per Cent of Moisture in Coal
Heating value as determined by a calorimeter
Net heating value
Theoretical maximum efficiency

Fig. 1—Effect of moisture on the value of coal

Based on 14,000 B.t.u. per pound of dry coal, flue gases 500 deg. F., and 16 lb. flue gas per pound of coal.

occasionally, the pyrites may undergo oxidation according to the following reaction:

$$2FeS_2 + 7O_2 + 2H_2O = 2FeSO_4 + 2H_2SO_4$$

This reaction is accompanied by the production of heat and is thought to be one of the contributing causes in producing a coal-pile fire. It results in an increase in volume and a consequent disintegration or slacking of the lumps of coal.

The products of the combustion of sulphur may combine with water vapor to form sulphurous of sulphuric acid, which, under favorable conditions, may corrode economizers, breechings, steel chimneys or other metal parts with which the gases come in contact. The sulphur in the ash has a corrosive action on the steel parts of ash-handling equipment. The iron in the pyrites (FeS_2) may combine with some of the constituents of the ash to form a slag of low melting temperature which

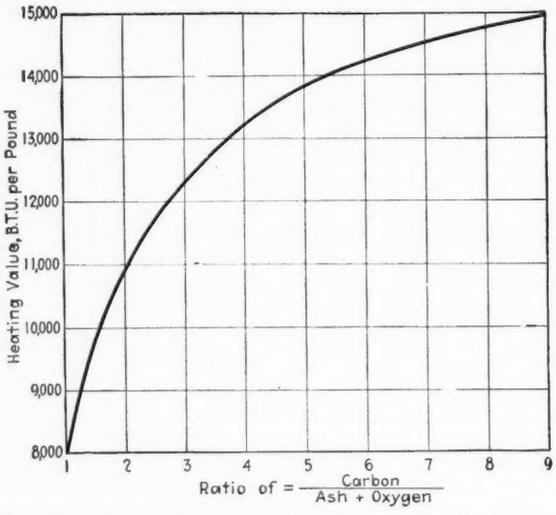


Fig. 2—Effect of oxygen and ash upon heating value

will seriously interfere with the burning of the fuel. High-sulphur coals cannot be used in the manufacture of metallurgical coke.

Effect of Ash

Ash is composed of the incombustible constituents of coal. It should not be confused with the "ash and refuse" discharged from a grate or stoker, as the latter contains combustible material, while part of the ash may have been discharged into the air through the chimney with the products of the combustion. The ash content is derived from three principal sources: (1) The original mineral content of the vegetal matter; (2) sand, clay or shale deposited during formation of the coal bed, and (3) extraneous impurities from the floor and roof of the mine.

As in the case of moisture, ash is inert and reduces the heating value directly in proportion to the amount present. It is not only necessary to pay freight on this inert matter, but the operator is confronted with the problem of disposing of the ash after the coal has been burned. Ash is a bad material to handle because of its abrasive and corrosive properties. If present in large quantities, it seriously interferes with combustion by choking the air passages and separating the air from the combustible matter in the fuel and may materially reduce the output obtainable from a boiler. The loss of unburned carbon in the ashpit is much greater with high-ash coals than with those low in ash. The influence of ash on capacity and efficiency of boilers is indicated in Fig. 3. The cost of labor for cleaning fires and handling ashes may be increased considerably by the use of a fuel that is high in ash.

Clinker Formation

The ash present in many coals will soften or fuse at the temperature ordinarily encountered in the fuel bed. The fused particles may be present in the fuel bed as

small balls of thick, viscous material which solidifies upon being cooled slightly and does not adhere in large masses. On the other hand, if a soft clinker is formed which is semi-fluid, it may spread and inclose large amounts of unburned fuel or settle on the grate and choke the air passages. Such clinker formations will seriously limit the amount of fuel that can be burned. If clinkers are formed as small hard lumps which the stoker can

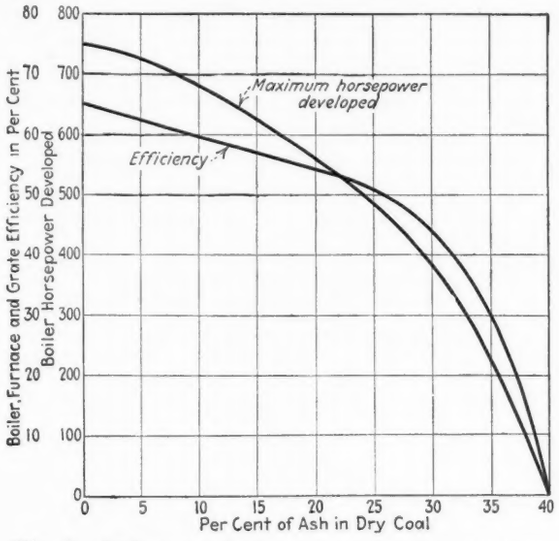


Fig. 3—Influence of ash on capacity and efficiency

(Reported by W. L. Abbott in *Jour. Western Soc. of Engineers*, Vol. II.)

dispose of readily, they may cause no trouble. Consequently, in the selection of a fuel, the clinkering tendencies may be of more importance than the heating value of the coal.

The analysis of the ash obtained by the complete combustion of most coals will come within the limits as indicated in Table I[3].

TABLE I—TYPICAL LIMITS OF ASH ANALYSES

Constituent	Per Cent	Constituent	Per Cent
SiO_2	40-60	CaO	1-15
Al_2O_3	20-35	MgO	0.5- 4
Fe_2O_3	5-25	Na_2O+K_2O	1- 4

The softening temperature of most of these constituents is well above that found in the fuel bed of the ordinary furnace. The clinker formations are due mainly to the chemical reaction between silica (SiO_2) and the basic oxides of iron or lime. In particular, if iron is present as ferrous oxide (FeO), it will unite with silica to form a ferrous silicate having a low melting temperature. The combustion of iron pyrites (FeS_2) in a reducing atmosphere such as exists in the ordinary fuel bed, favors the formation of ferrous oxide. It is on this account that high-sulphur coals have a reputation for producing bad clinkers, although the trouble is not caused by the sulphur but by the iron. High-sulphur coals that are low in pyrites may cause little trouble from clinkering.

The formation of clinkers depends on the temperature of the fuel bed, the relative proportions of silica and the basic oxides and the absence or presence of oxygen. There is apparently no definite relationship existing whereby the clinkering tendencies of a coal can be predicted with any degree of reliability from a chemical analysis of the ash. In general, those coals whose ash is high in iron or calcium oxides and correspondingly lower in silica, seem to produce clinkers most easily. If there is an insufficient supply of oxygen in the fuel bed, the iron compounds are reduced to ferrous oxide which unites with the silica at low temperatures to form a slag. On the other hand, in an oxidizing atmosphere the iron compounds may exist as ferric oxides, which are more refractory and will not form a silicate except at a higher temperature. Experiments by Marks[4] and the Bureau of Mines[5] indicate that the temperature at which an ash will soften may vary by as much as 200 to 500 deg. F., depending upon whether it is heated in an oxidizing or a reducing atmosphere. Ash in the lower part of the fuel bed will not clinker as rapidly as that in the upper part of the fuel bed because (1) it exists in an oxidizing atmosphere that favors the formation of ferric oxides and (2) it is at a lower temperature resulting from the cooling action of the air flowing upward through the fuel bed.

TABLE II—FUSIBILITY OF ASH*

Coal Bed	Number of Samples	Average Softening Temperature Deg. F.	Average Analysis in Per Cent Dry Coal: Ash	Sulphur
Eastern Coals				
Pennsylvania:				
Scranton Anthracite District	7	3,010+	12.39	0.79
Wilkes-Barre Anthracite District	4	3,010+	13.17	0.78
Pittsburgh Bed	34	2,360	7.17	1.43
Upper Freeport Bed	98	2,365	9.11	2.06
Lower Freeport Bed	80	2,385	7.66	2.64
Upper Kittanning Bed	24	2,349	8.86	2.42
Lower Kittanning Bed	180	2,506	8.20	2.18
Virginia:				
Pocahontas No. 3 Bed	28	2,420	4.26	0.54
Upper Banner Bed	31	2,399	6.88	0.75
Imboden Bed	19	2,606	7.72	1.08
West Virginia:				
Pittsburgh Bed	78	2,156	7.49	2.40
No. 2 Gas Bed (Kanawha)	40	2,670	5.84	1.07
Beckley Bed (New-River)	174	2,785	5.23	0.75
Sewell Bed (New River)	158	2,518	4.85	0.86
Pocahontas No 3	303	2,495	5.05	0.60
Eastern Kentucky:				
Elkhorn Bed (New-River)	33	2,470	3.96	0.68
Harlan Bed	55	2,660	4.03	0.91
Alabama:				
Mary Lee Bed	18	2,800	10.74	0.75
Black Creek	12	2,530	3.31	0.83
Thompson	10	2,230	8.85	0.52
Middle-Western Coals				
Illinois:				
No. 2 Bed	15	2,010	9.97	3.58
No. 5 Bed	36	2,000	10.77	3.35
No. 6 Bed	161	2,160	10.27	2.30
Indiana:				
No. 3 Bed	11	2,090	10.61	4.34
No. 4 Bed	30	2,390	8.17	1.62
No. 5 Bed	29	2,130	10.23	3.54
Western Kentucky:				
No. 9 Bed	79	2,020	10.50	3.67
No. 11 Bed	47	2,030	9.57	4.08
Kansas:				
Cherokee Bed	12	2,070	10.10	4.08
Weir-Pittsburgh	8	1,997	12.24	5.31
Missouri:				
Bevier Bed	51	1,966	13.73	5.16
Lexington Bed	41	1,996	13.87	4.08
Oklahoma:				
Lower Hartshorn Bed	29	2,045	5.93	1.36
McAlester Bed	43	2,171	8.44	2.50

* Data from "Coal Catalog," Keystone Consolidated Publishing Company based on analyses reported in Bureau of Mines Bulletin.

The softening or fusing temperature of the ash from the important coals of the country has been determined by the Bureau of Mines[6]. Table II gives the results obtained from a number of different coals. These figures represent the averages of the different beds. The softening temperature of a coal from a particular mine in one of these beds may vary from the average by as much as 150 to 200 deg. F. It will be noticed that the coals from the Appalachian region have a fusing temperature that is several hundred degrees above that of the Mid-Western coals. Coals may be classified as follows, on the basis of their softening temperature:[7]

[3]Bureau of Mines Bulletin 129.

[4]Marks, L. S., "The Clinkering of Coal"; Jour. Am. Soc. Mech. Eng., Vol. 37, 1915.

[5]Bureau of Mines Bulletin 129, "Fusibility of Coal Ash."

[6]Bureau of Mines Bulletin 209.

[7]Bureau of Mines Bulletin No. 209.

Class 1, 2,600 to 3,100 deg. F., including the anthracite coals and the lower and older bituminous coals; ash is refractory, giving no trouble from fusion.

Class 2, 2,200 to 2,600 deg. F., including the bulk of the bituminous coals in the Appalachian region; ash is of medium fusibility and generally causes little trouble if the coal is properly fired.

Class 3, 1,900 to 2,200 deg. F., including most of the poorer grades of bituminous coals in the country; ash fuses easily and clinkering troubles may be serious.

The softening temperature of the ash is not entirely satisfactory in determining the clinkering tendencies of a fuel, as the viscosity of the fused mass is important. If the fused ash or slag is highly viscous, it will not flow readily and will solidify into lumps that can be easily handled by the stoker. The more fluid clinkers may spread rapidly and are consequently more troublesome. In fact, the silicate formed by the reactions of silica and ferrous oxide is not only fluid, but will dissolve both the silica and oxide, increasing the tendency to spread.

Coal Washing

Over 600 million tons of coal are handled annually by the railroads of the United States. If 10 per cent of this material is inert ash, the expense of hauling it from the mine to the consumer and of disposing of the residue after the coal is burned represents an enormous item. During the coal shortage of 1917-18, caused by the World War, the ash content of coal increased about 5 per cent on account of careless methods in use at the mines. This threw an additional burden of about 25 million tons upon the railroads of the country.

Part of the ash in coal comes from the floor and roof of the mine and from seams and parting in the bed. The extent to which this foreign matter is excluded depends upon the care exercised at the mine. Where miners are paid on the basis of the weight of coal mined, the loading of slate and impurities is convenient and profitable for the miner unless a system of dockage is used. At some mines the coal is passed over picking belts to remove the larger lumps of impurities. Lump coal can be cleaned quite well by this method. At many anthracite mines and at some bituminous the smaller sizes of coal, which are high in ash, are cleaned by washing.

Letters from an Oil Engine Operator

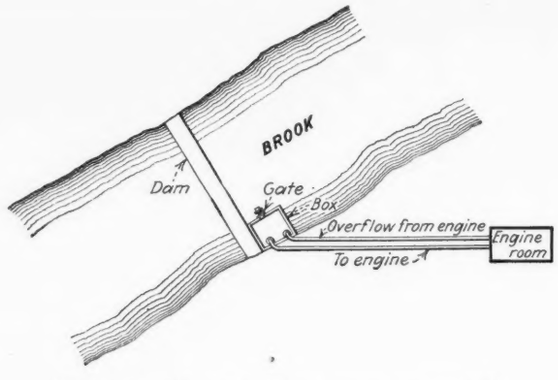
A Kink on Cooling Water

Dear Ed.: Leave it to yours truly to stumble into an oil-engine plant if there is one around. I was going up the Hudson, homeward bound for the holidays, when we came to a cut in the rock that was being widened for another set of tracks. They made a mistake with one of their blasts and tumbled a rock as big as a church right on the track. The train was tied up for an hour and a half while they got the track cleared, and I took a walk down a gulley, where I had heard some suspicious puffs.

I found four 100-hp. oil engines driving as many compressors and delivering about 2,000 cu.ft. of air per minute out over the lines to the jackhammers. I was somewhat surprised to learn that oil engines are playing such an important part in construction work, but come to think of it, they are ideally suited to this work in view of their economy as compared to other methods of supplying compressed air for rock-drilling purposes. I don't care where you go or what engine room you visit, you will always find some little kink that is worth while, and although this was perhaps the crudest sort of an engine room I ever saw, I found just that.

The engineer had learned that the ideal method of cooling an oil engine is by means of a maximum flow of water and a minimum rise in temperature, and as winter came on he ran into difficulty in maintaining an inlet temperature of his cooling water sufficiently high to insure anything like an ideal flow. He was lifting the water from a dam in a little brook below the engine room, and a portion of this water was being pumped to different points in the construction camp, to the locomotive tank, the steam shovels and the cook's car.

They had already encountered some trouble with the uncovered pipes freezing up. The first step taken to remedy this condition was to return the overflow from the engine and air-compressor cylinder jackets to the dam, but there was not enough heat in it to keep the entire body of water warm. Then they built a box



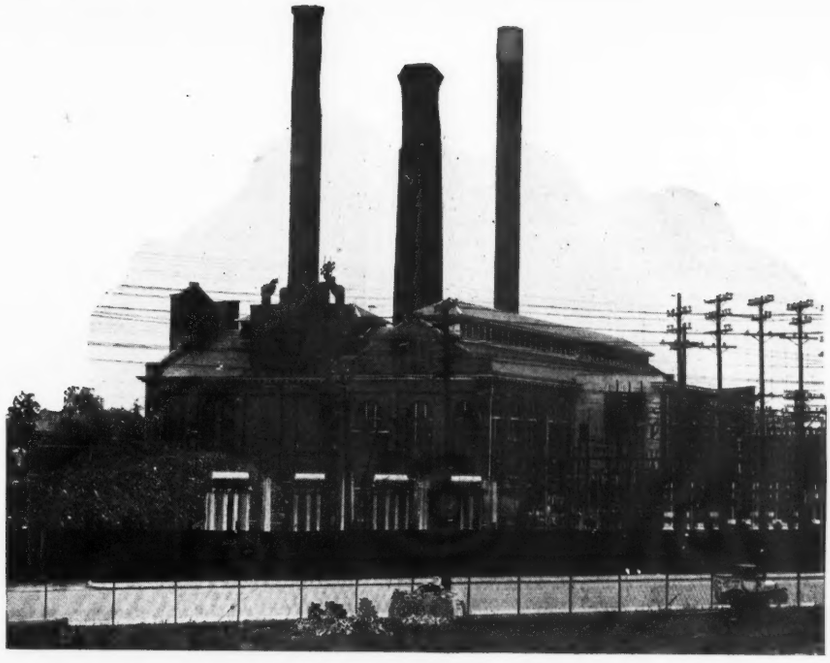
The way the water lines were connected

around the strainer on the end of the pump suction line and piped the warm water from the engines into this box as I have sketched. By manipulating a gate in the end of the box, they controlled the temperature of the water going to the circulating pump, and since a part of this water was being distributed about the camp, they killed two birds with one stone, for the water mains were carrying a temperature of about 75 deg. F., sufficient to keep them from freezing.

The engineer had a few kicks to register and appeared to be glad of the presence of a kindred spirit in which to confide. He said that rock drillers as a class were the dumbest men he ever worked with, including the superintendent. When they got a little water in their machines from the condensate in the air lines, they would open a drain and blow away more air than two machines would use. If the air pressure went low through putting on too many machines, every man of them would throw his machine wide open and swear at the engineer. Sometimes when they overloaded an air main and thus reduced the pressure at the far end, the superintendent would come along and insist upon starting up another machine, even though the ones in operation were unloaded half the time and the pressure at the power house was above normal.

Such things occur whether the plant is oil-engine driven or otherwise supplied with power.

I was not sorry on account of the delay even though the folks were worried and afraid there was a wreck on the line. Best wishes, E. O. Leseid.



Mill street station has 50,000-kw. capacity

COMBUSTION CONTROL *Increases Boiler-Plant Effieiency*

By Raymond F. Forbes

Research Engineer, Indianapolis Power & Light Company

In THE Mill Street station, one of three of the Indianapolis Power & Light Company, there are installed 50,000-kw. generating capacity and eleven boilers, the latter with a combined water-heating surface of 95,310 sq.ft., equipped with underfeed stokers and forced-draft fans. Until about one year ago the boiler plant was on hand control, when the company's engineers became interested in the Hagan Corporation system of combustion control as a possibility of improving the economy. This led to an installation of this system on one boiler in the Mill Street station. Since that time six more boilers have been equipped, making a total of seven now under automatic regulation.

On this system there is a master regulator that functions on variations in the steam pressure. These variations are transmitted by sending regulators, using low-pressure air as the sending medium, to receiving regulators on individual boilers or banks of boilers. These receiving regulators act as master regulators for the boiler or banks of boilers under combustion control.

In the plant under consideration each boiler has its individual forced-draft and stoker drive and the boilers are located in two rooms. They are connected by a ring header with the connections for the turbines taken off one side of the header. A steam condition of 235 lb. gage and 175 deg. F. superheat is used. On this station the greater part of the system load is carried, which varies over wide ranges.

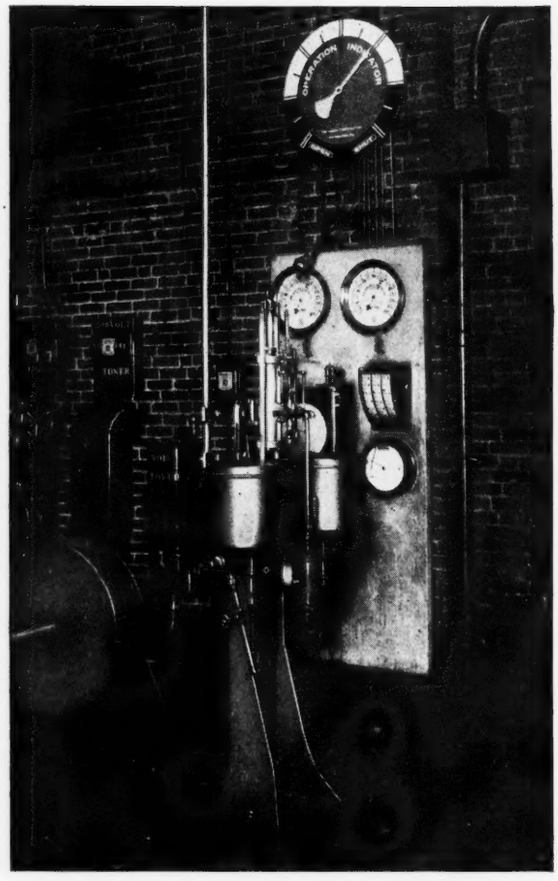
Four of the seven boilers under automatic control, each having a heating surface of 7,950 sq.ft., are in one room and are arranged in two batteries of two boilers each. The other three units, equipped with combustion control, have a heating surface of 10,570 sq.ft. each and are in another room.

Compressed air for use in the power cylinders of all controllers is supplied from the station compressed-air system at 85 to 100 lb. pressure during the day, but at night, when the main compressor is down, air for the controllers is supplied by a 28-cu.ft. compressor at a pressure of 65 to 120 lb. These air-pressure variations cause no trouble.

Mounted in the heater room between the two boiler plants is a master-regulator panel, Fig. 1. On the back of this panel is the master regulator, which is actuated by the variations of steam pressure in the main header. This regulator, in turn, operates two pressure-sending regulators, Fig. 2, mounted on the rear of the panel at the opposite end from the master regulator. Steam-pres-

sure variations are transmitted by these sending regulators through air piping systems to a receiving regulator mounted on each of the three boilers in one boiler room, and to one receiving regulator mounted on each of the two batteries of two boilers in the other boiler room. These receiving regulators act as master regulators for the boilers.

Mounted on the face of the master regulator at the top of the panel, as shown in Fig. 1, are the steam- and air-pressure gages and two load indicators actuated by the pressure transmitted by the sending regulators. Beneath these load indicators may be seen two manual adjusting devices by which the load on the two groups of boilers



ment board are steam and feed-water pressure gages, a steam-flow, air-flow boiler meter, a three-point draft gage and a temperature recorder.

Fig. 1 (Below, left)—Master regulator panel from which seven boilers are controlled

On the front of this panel are mounted the steam and the air pressure gages, two load indicators, handwheels for adjusting the load on the two groups of boilers and the handwheels by which the control of the boilers can be changed from hand to automatic or vice versa.

Fig. 2 (Below, center)—Sending regulators mounted on the rear of the master regulator panel, Fig. 1

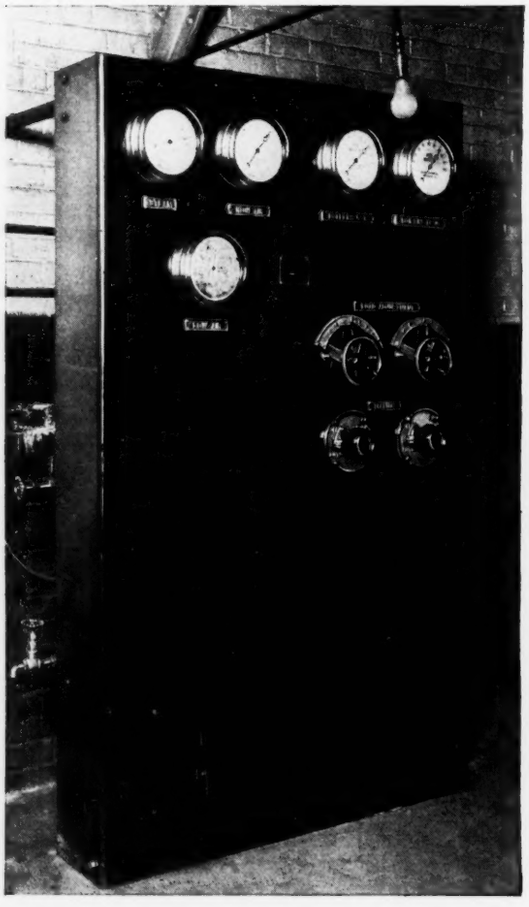
The sending regulators transmit steam-pressure variations, by means of low-pressure air, to receiving regulators in the two boiler rooms.

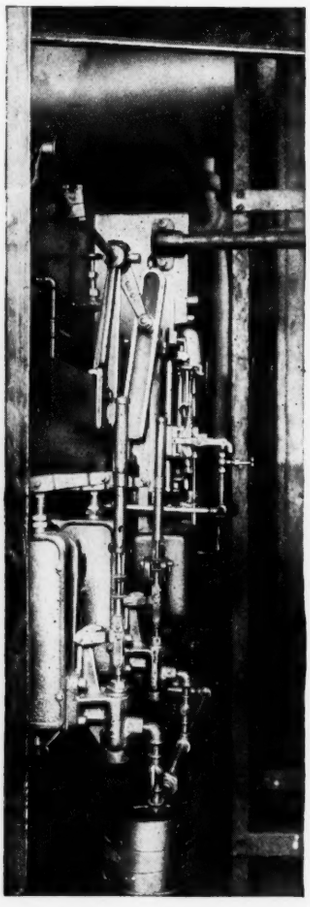
Fig. 3 (Below, right)—Receiving regulator mounted on the boiler-room wall

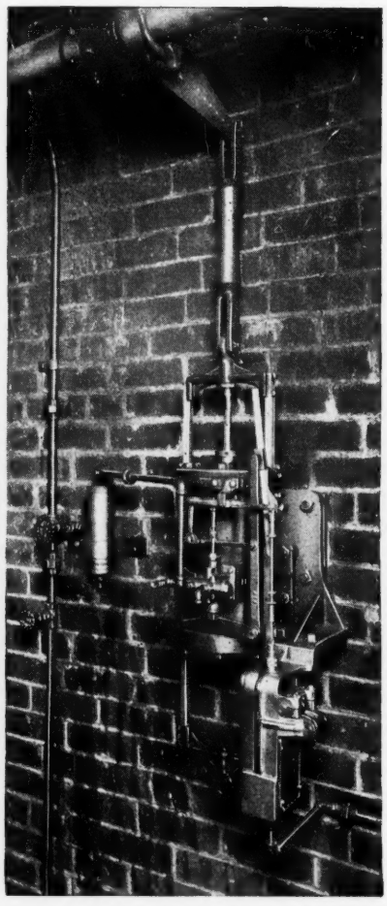
This regulator, by means of a lever system shown at the top of this picture, operates the dampers on 10,570-sq.ft. boiler in accordance with the steam-pressure changes in the main header and transmitted by the sending regulator.

Fig. 4 (Right)—Combustion controller mounted on the front of one 10,570-sq.ft. boiler

This regulator controls the air pressure under the stoker by adjusting the position of the louvers in the windbox. The forced-draft fan is driven by a constant-speed motor. Above the meter panel is an indicator to show the position of the boiler-room stack dampers. Mounted on the instru-







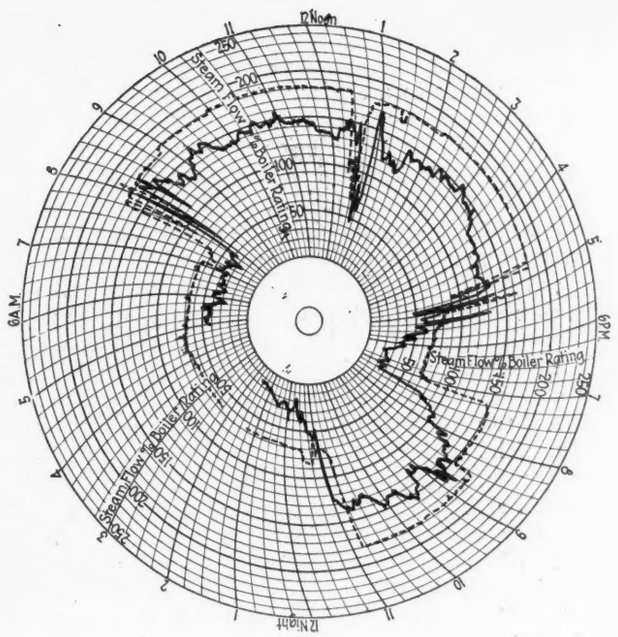


Fig. 5—Steam-flow air-flow chart from a 7,950-sq.ft. boiler under hand control

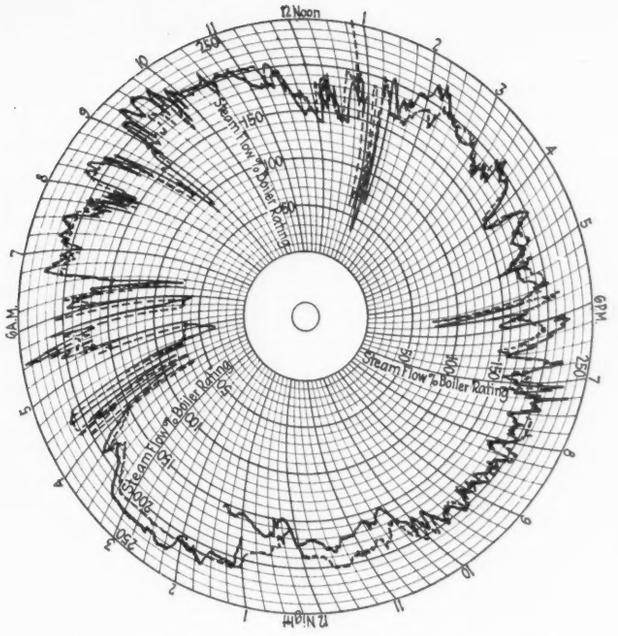


Fig. 6—Steam-flow air-flow chart from the same boiler under automatic control

The chart, Fig. 6, is from a boiler that is used to carry the load swings, nevertheless the steam and the air lines follow closely together, but are widely separated on the chart, Fig. 5, when the boiler was operating at a fairly constant load. The air-flow is shown in dotted lines and the steam flow in full lines.

may be equalized or set to suit any steam distribution from the main header, as influenced by the number and location of turbines in service. Below these manual devices are two control wheels by means of which either or both groups of boilers may be instantly changed from automatic to complete manual control, or vice versa.

As both fan and stoker motors are driven by constant-speed alternating-current motors, no regulation is possible by control of the motors. Variation of air flow is secured by changing the position of the louvers in the windbox, by combustion controllers located on the boiler-room floor. The firemen were quick to appreciate the value of the combustion controllers, and vary the fuel feed by shifting the stoker gears in accordance with the indicator in full view at one end of each boiler room. One of these indicators is shown at the top of Fig. 4. The indicators show the position of the stack dampers.

One receiving regulator serves the two 7,950-sq.ft. boilers in a battery. When cleaning fires or blowing soot in either boiler of a battery, the hand reversing valve on the receiving regulator is set to take the regulator off automatic control and to open the stack dampers of both boilers. The louvers on the forced-draft fan, serving the boiler to be cleaned, are closed by means of the hand reversing valve on the combustion controller. The decreased output of this boiler is then at least partly

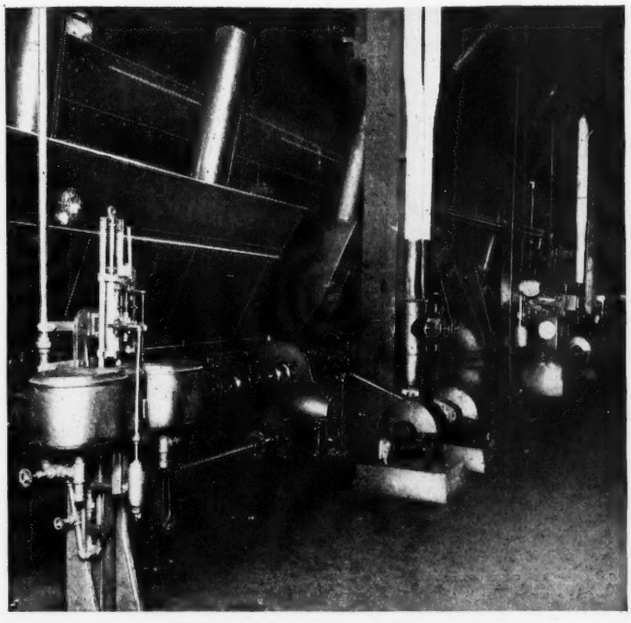


Fig. 7—Two batteries of two 7,950-sq.ft. boilers, each battery equipped with automatic control

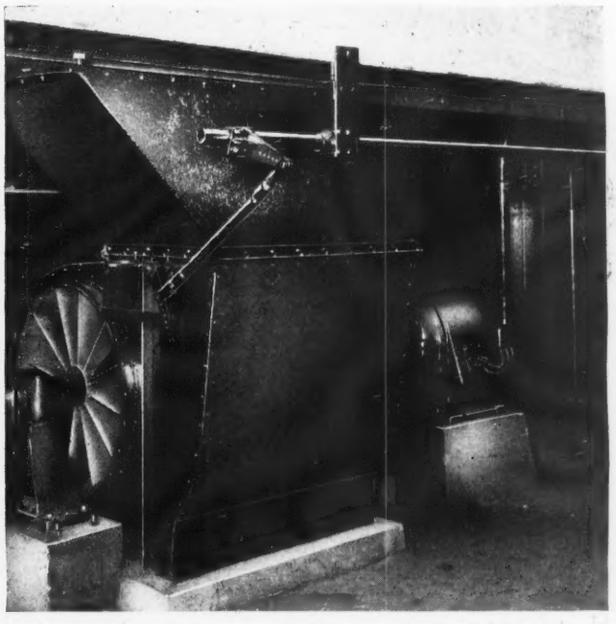


Fig. 8—Forced-draft pressure controlled from a combustion regulator on boiler-room floor

borne by the other boiler in the battery because its stack damper is now wide open. Thus one receiving regulator on two boilers in a battery is useful when cleaning fires or blowing soot.

The installation complete with the master regulator has been in satisfactory service three months. All the equipment is of the sturdy construction required in a boiler room and occupies small space. The different pieces of apparatus require little attention, oiling by the boiler-room oiler and an occasional inspection by the plant instrument man being the only labor required on them.

Operation of the Controller

How the controller functions is indicated by the steam-flow and air-flow graphs drawn on the boiler meter charts, Figs. 5 and 6. The master regulator is sensitive to header pressure variations of ¼ lb., but regulates the stack dampers from wide-open position at 232 lb. pressure to a practically closed position at 248 lb. These limits of steam pressure were established to give uniformity of combustion conditions rather than uniformity of steam pressure, as the former is more desirable. The combustion controller maintains the draft above the fires between the limits of 0.09 and 0.11 in. of water without excessive temperatures in the furnaces, at 175 to 200 per cent rating.

Since the installation was completed the average monthly over-all boiler-room efficiency has been increased from 71 to 74 per cent, this gain being attributed to the performance of the combustion-control system. Further marked economies are anticipated by reductions in furnace and stoker maintenance costs. Experiments are to be made by reducing the draft over the fire to 0.07 in. of water to determine if the resulting temperatures will be destructive of brickwork.

The uniform flow of air through the boiler as afforded by the control system, it is believed, cools the stoker parts more effectively and maintains a more uniform furnace temperature for the brickwork than is possible with hand regulation. These uniform furnace temperatures also mean more uniform superheat and water circulation, resulting in cleaner tubes, better heat transfer and fewer tube replacements. The complete installation has been so satisfactory that at the end of the year it is expected the boiler-room operation costs will show a saving to justify the cost of installation.

Vibrations in Oil-Engine Crankshafts

By W. E. Warner

VIBRATIONS and critical speeds are fortunately rare in Diesel engines working under normal conditions, but at times they have caused breakdowns. When an engine is built, the various rotating parts are designed so that no major critical speed exists within the normal operating range. This object is usually secured, but there may be minor critical speeds, which are as a rule harmless. When the engine is installed and coupled to the machinery it has to drive, a major critical speed may exist, as this is not now governed by the engine shafting only, but by both the engine shafting and any other direct-coupled shafting.

This shows that a successful performance on the test bed as far as vibration is concerned may not be obtained under running conditions when connected to other machinery; that the type of engine installed has given satisfaction in other places does not prove that vibrations will not occur.

Critical speeds in a shafting system may be detected by an instrument known as a torsiograph. This is connected to the shafting by a belt and draws a curve from which can be calculated the existence and magnitude of any critical speeds that may exist.

If a major critical speed is thought to exist in the operating range, means should be taken to remove it. This can most conveniently be done when the installation has been carried out by altering the weight or position of the flywheel or by using a flexible coupling between the engine and the driven shafting.

In one instance a 150-hp. Willans Diesel engine was converted to drive an electric generator in a small power station. The engine vibrated badly when running; the makers, upon being informed, recommended a slightly heavier flywheel. When a heavier flywheel was fitted and properly balanced, the engine gave no more trouble through vibration. Using a flexible coupling between the engine and the driven shafting is also an effective remedy, and where possible engines should be so coupled.

Airless-injection engines give less trouble through vibration than do air-injection units. The addition of the compressor on the crankshaft makes balancing more difficult. A compressor that is badly balanced in itself or that works stiffly, will obviously affect the crankshaft as regards balance and vibrations. Therefore, compressors should always be kept in good order. Even though the vibrations may be insufficient to cause fracture, they are likely to cause failure by fatigue, and in time the shaft may fracture at some weak spot. Nearly all engines work best on one particular speed, and any speed at which the engine vibrates should be strictly avoided.

If a shallow pan of water be placed on the engine bedplate, the speed at which there is least vibration can be seen by watching the ripples on the surface of the water. On any engine there is sufficient vibration to cause slight ripples. These ripples should be watched as the speed is varied, and the speed chosen for the running speed at which the ripples are smallest.

Dollars from B.t.u.

B.t.u. chasing is the king of indoor sports and one of the few that yields a worthwhile profit. The modern cement industry offer some good examples of the conservation of heat and dollars by intelligent design and operation. Read Paul Van Zandt's article in the August 7 issue. His story of a modern cement mill is a money saving lesson for other industries less highly organized technically.

Let Us Have UNIFORMITY *in* DIESEL-FUEL-OIL *Specifications**

By G. H. Michler
Standard Oil Company of New Jersey

THE growing importance of the Diesel engine as an economical power unit cannot be overestimated. In one of its principal fields, the marine trade, its growing ascendancy over steam power plants is attested to by Lloyd's marine-construction figures for the year 1927, which reported that for the first time in history world-wide construction of Diesel ship tonnage exceeded construction of steam tonnage, the comparison being as follows:

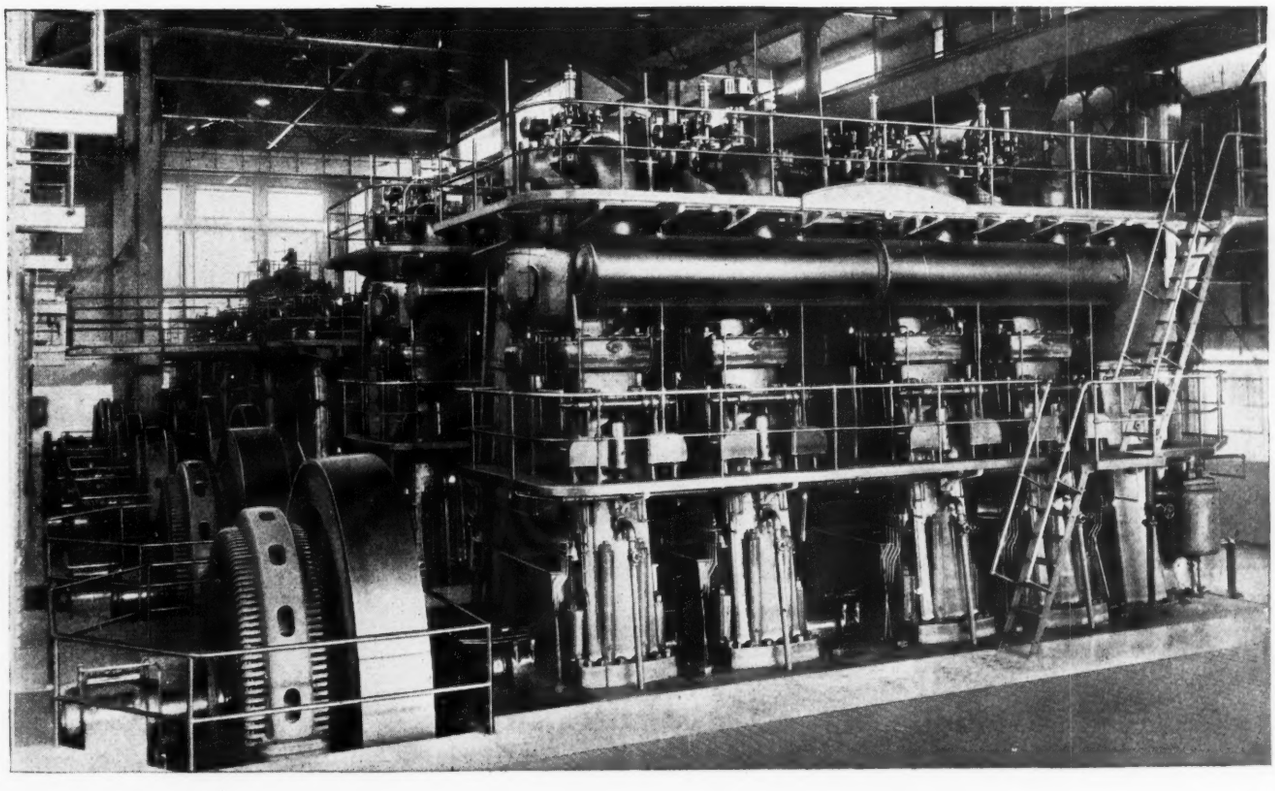
	Steamers,		Motor Vessels,	
	No.	Deadweight, Tons	No.	Deadweight, Tons
American	11	71,900	8	18,670
Foreign	364	1,422,000	277	1,590,848
	375	1,493,900	285	1,609,518

It will be noted that in Europe where the construction of motor vessels is considerably more advanced at the present time than in this country, motorship construction during the year surpassed steamer construction by about 200,000 deadweight tons. This represented a considerable advance in Diesel construction over 1926, in which 925,837 deadweight tons of steamers were constructed as compared to only 701,777 deadweight tons of motorships.

When we consider that the fuel consumption in these large units bears a ratio of one to three as compared to fuel oil burned by steamers under boilers to develop the same horsepower in comparable tonnage, the importance of the Diesel engine as a factor in conserving the future world oil supply can be appreciated. Its advantage to the operator, particularly of freight ships, on long trade routes, is decided. His fuel consumption is materially decreased, making available more space in the ship for freight-earning cargo and requiring him to make fewer stops for fueling purposes. A good illustration of this is furnished by the recent development by some shipping

* Paper presented at the National Meeting of the A.S.M.E. Oil and Gas Power Division, State College, Pa., June 14, 1928.

Fig. 1—Nordberg Diesels in Mexico burn a heavy Mexican oil



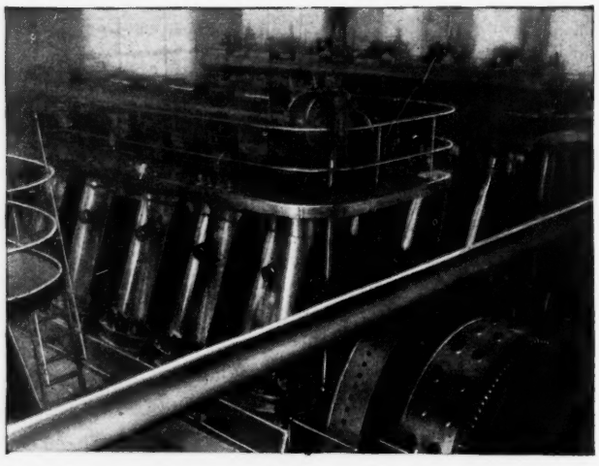


Fig. 2—Fulton Diesels burn California fuel oil

companies of a fast round-the-world freight service by Diesel ships which, in some instances, practically bunker for the entire round at one port.

Everything apparently justifies the operators' investment in a comparatively high-priced piece of mechanism, but there is, as usual, a fly in the ointment. In this case it is the various types of Diesel oil required by different engine builders, and passed on by them to operators as a basis of performance guarantees.

Let me cite some examples: A couple of years ago a motorship made her maiden voyage from a United Kingdom port to the United States. The following is a comparison of oil supplied the vessel in the United Kingdom and oil supplied by our company in New York:

	United Kingdom Sample	New York Sample
Gravity at 60 deg. F.	26.7	30.2
Flash, Pensky-Martens closed cup, deg. F.	175	175
Viscosity, Saybolt, at 100 deg. F.	98	50
Sulphur, bomb method, per cent	1.34	0.4
Carbon residue, per cent	3.05	0.4
Asphalt, Italian tar test, per cent	45	6
Ash	None	None
B.t.u. per lb.	19,125	19,400
Water and sediment	Trace	Trace

At the time of delivery our knowledge of requirements of marine Diesel engines led us to believe that the oil furnished by us was much superior to that furnished on the other side, and we believe that most Diesel-engine manufacturers would be of the same opinion. This is apparently borne out by the specifications issued by marine-Diesel builders from time to time.

In actual operation of the vessel, however, serious trouble was encountered, and all the trouble was laid to the oil by the operators of the motorship. As an experiment we mixed 40 per cent of a heavy residue oil with Diesel oil, which had the result of reducing the gravity, increasing the viscosity, sulphur content and coke residue, and very materially increasing the asphalt content by what is known as the Italian tar test, also reducing the B.t.u. per pound. In other words, the oil was brought to what we consider a poorer quality and made to conform more nearly to the grade of oil delivered in the United Kingdom, which appeared to operate successfully. Whether the trouble was due to the grade of oil delivered or mechanical troubles of the engine we are not in position to say. Under any circumstances, the operators claimed that by blending what we considered an inferior oil, their troubles were overcome. This is only one illustration of the difficulties we have encountered.

One of the largest customers of the company which I represent, who buys a considerable volume of Diesel oil for his ships at North Atlantic and United States Gulf ports insists on various specifications for different ships, although all of them were engined by the same company in Europe. For some of his vessels he requires a maximum sulphur content of 0.75 per cent and a minimum gravity of 26 deg. Baumé. For other vessels he limits the maximum sulphur content to only 0.5 per cent and stipulates that gravity shall not be below 27.5 deg. These specifications are drawn in accordance with the guarantee of the engine builder. Vessels with engines of the same make have operated successfully for years on the West Coast on an oil with a sulphur content of over 1 per cent, and gravity at times as low as 24 deg. For several years our company had a contract with another ship operator who required Diesel oil of a minimum gravity of 33 deg. A.P.I. Builders' specifications were again given as the reason.

Another of our contract customers requires the following minute specifications of Diesel oil for delivery to his ships:

Viscosity at 100 deg. F. Saybolt Universal, sec., maximum	100
Gravity, deg, Baumé	25+
Flash point, Pensky-Martens closed cup, deg. F.	150+
Ash, per cent, not more than	0.05
Hard asphalt, insoluble, per cent, less than	1
Coke, per cent, not exceeding	1.5
Hydrogen, per cent, not less than	11
Carbon, per cent, not less than	86
Oxygen, per cent	None
Cold test, deg. F., not more than	46
Water, per cent, not to exceed	0.5
Sulphur, per cent, not more than	1
B.t.u. per lb.	19,000+

It is natural that Diesel-engine builders should wish to insure a supply to their engines of fuel oil ideally suited for their best performance. It is further natural that in the course of evolution, through which any new type of machinery must advance toward perfection, there should be a wide variation in the ideas of different manufacturers as to what constitutes a suitable fuel for their particular engine.

One present phase of evolution is that manufacturers are endeavoring to construct engines which will operate on heavier oils. In doing this it seems that these engines will not operate on lighter grades of oil such as are considered more desirable for other engines. Each manufacturer seems to have a different idea of the grade of oil required for his particular engine. Sulphur is sometimes

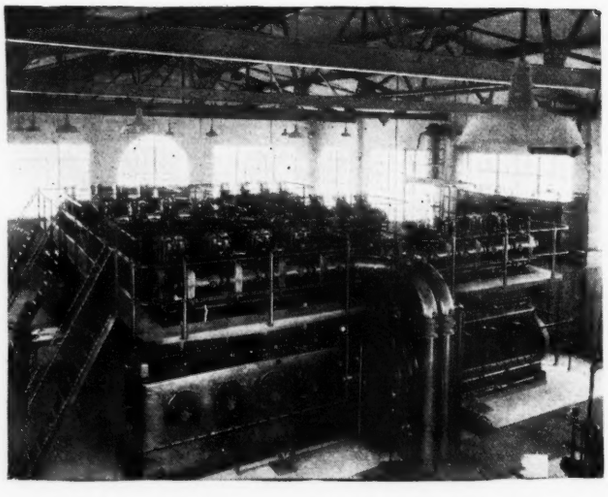


Fig. 3—1,000-hp. Ingersoll-Rand engines in a Nevada cement mill use a California fuel

blamed for all troubles encountered, and some manufacturers, as mentioned previously, are requiring that oil should be used containing not more than 0.5 per cent of sulphur. It is our view that to limit sulphur to this low percentage is unnecessary, and further it is our view that a great many of the other specifications demanded are unnecessary. During the early period of development of the Diesel engine, such varying requirements in fuel specifications were perhaps excusable. Is it not a fair question to ask today, however, whether the Diesel engine has not developed to a point where such minute and variable specification restrictions are no longer either necessary or desirable? Their continuation can have only one result, and that an unfavorable one to the further progress of the Diesel engine, higher cost of Diesel fuel oil.

In a great many cases the exacting specifications now required cannot be met, or if they can be met the oil can only be delivered from refining centers, as the specifications demand running a special batch of oil, carrying it in separate tankage, and delivering through clean lines or barges so that the oil will not become contaminated with what has heretofore been considered a standard grade of Diesel oil. Take, for example, unnecessarily restrictive sulphur limitations. They may require the fuel-oil supplier to manufacture a special batch of Diesel oil from low-sulphur crudes, which either may not be available when delivery is wanted or else are considerably more expensive than crudes of a higher sulphur content that would be suitable for the manufacture of Diesel oil of a more liberal sulphur specification.

It is clear that there must be considerable latitude in drawing up Diesel-oil specifications. An exacting specification drawn up to meet a Diesel-engine fuel oil that might be made from Mid-Continent crudes would quite likely not be met with Diesel-engine fuel oil produced from California, Venezuela, Mexico, or Texas crudes, nor could such a specification be met by refiners who are running a great number of mixed crudes. In other words, if an attempt is made to segregate crudes to produce Diesel oil only from a selected crude, the cost of the product would be high.

As we see it, the successful development of the Diesel engine is dependent on a supply of Diesel-engine fuel oil at the lowest possible price. The main obstacle in the future to a reasonable price is the lack of a standard Diesel-oil specification with sufficient flexibility to permit refiners to utilize crudes from various sources and to carry one grade of Diesel oil in tankage at different points. Unless this is done, the future progress of the Diesel engine is going to be very materially handicapped. This handicap will be twofold: in the first place, the cost of manufacturing, handling and storing a variety of different grades of Diesel oil may cause the price to mount to a point where it would destroy the economy which rightly belongs to the Diesel engine due to its low fuel consumption. In the second place, unless Diesel engines are constructed which can operate efficiently on a standard grade of Diesel oil of broad specifications, ship operators will be unduly restricted to limited points of fuel supply. This feature might very easily preclude their operation in the most desirable trade services.

From the standpoint of the oil companies the question of specifications is considerably simplified if they are limited to three: minimum gravity, sulphur content, and

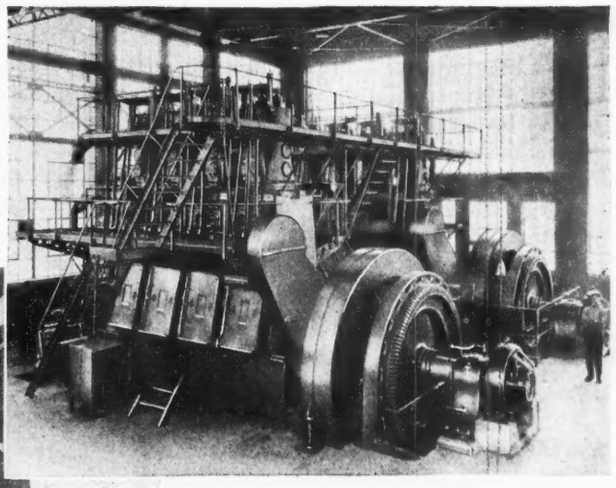


Fig. 4 (Above) — McIntosh-Seymour Diesels in Wichita, Kan., flour mill burn Mid-Continental fuel

Fig. 5 (Left)—De La Vergne Diesels in Maryland light plant use a low-grade oil

flash. With regard to the first, it is our feeling that a minimum gravity of 24 deg. should be generally satisfactory. We believe that a maximum sulphur content of 1.5 per cent should be acceptable. Minimum flash of 150 deg. closed cup has always been the standard. We should welcome an expression of opinion from you as to the suitability of these specification limits, and whether you do not feel that further restricting specifications are unnecessary.

I am sure all agree that advancement depends upon a suitable future supply of Diesel-engine oil at a reasonable price. I am equally sure that the builders and users have not been in a position to realize the fact that varied and restrictive specifications present a formidable obstacle to low-priced Diesel oil. The more liberal the specifications of oil demanded for Diesel engines, the greater the security of an adequate supply of fuel oil for them at a reasonable price in the future. To this extent the success of the Diesel engine is in the hands of its designers and builders.

Should a Girl Marry an Engineer?

By Celia M. Hobbs

SHOULD a girl marry an engineer? Any girl with a pleasant home, a well established place in the social life of her community and the advantages that accrue with such a life, might well consider this question. She must realize, of course, that a woman's social status is largely fixed by her husband's profession. She is aware, too, that a doctor's wife or a lawyer's wife is at once acceptable socially almost anywhere. And I shouldn't belittle the honor of being the helpmate of a good doctor, for there's something noble in bringing human happiness through health. And to help a lawyer or a minister build success is no slight thing.

But if one is observing, one will find that the successful engineer, too, has a most honorable place in any community—that he and his family associate with the "best people." True, even though an engineer be greatly successful, his income, through the years, will not rank with the fees of the successful lawyer, the doctor or the dentist. His wife will need to be equally as capable as he, in order to have the tasteful home every woman longs for, the needed help to afford her some leisure for the gentler arts, as well as to enjoy the educational and cultural advantages of her community and to educate her children properly. But all this is possible if her husband be successful.

And what is an engineer? He is one who erects great buildings that will endure, who spans mighty rivers with bridges of strength and beauty, or lays marvelous highways for easier and more enjoyable communication and transportation, joining North and South, East and West, in one great family; or he may furnish the power, the light and the heat for a great city. Indeed, he may be the man who constructs the Hudson River viaduct or designs the locks for the Panama Canal. Even though he is now only one of many at a dull drafting table, a grimy operator of an ice plant or a routine worker at a power plant, every girl hopes her husband will develop into a Stevens or a Goethals.

Civilization today might get along without the physician if people would behave themselves and give their bodies the proper care. It might possibly endure without the lawyer, and some few folks think we could manage without the minister and priest (although, personally, I think someone ought to take time to study the Good Book thoroughly and tell the rest of us what is in it), but imagine the world without an engineer! Why, we would still be reading by pine knots or crossing the Atlantic in sailboats.

An engineer is quite likely to be very practical, very exact. The nature of his training makes him so. He will doubtless have theories regarding efficiency in the home just as he has regarding the plant, and this will irk some girls with their delightful little reckless expenditures. If the girl be possessed of a vivid imagination and a keen love for the artistic and the beautiful, his ideas and his interests will at times seem prosaic and uninviting. But after all, it is worth something to have a husband who is careful and lays by enough money to meet the monthly onslaught of bills and still have a tidy sum for luxuries. As an old engineer friend once remarked, "Well, an engineer will always keep his wife in bread and butter." And sometimes there seems little else.

Nor will success come at once. It takes five years to establish even the beginning of an engineering reputation, ten or fifteen to attain the position of an authority on engineering problems. A wife may expect her husband to "just have to have" ten or twenty dollars' worth of recent books on engineering subjects, just when she has been considering buying that adorable little evening gown to replace the old rag she has endured for the last six months. Naturally, he must subscribe to all the periodicals along the lines of his profession in order to keep abreast of the times.

To the girl who loves to meet new people, travel a great deal and see something different, living as the wife of an engineer will seem very interesting. For an engineer just does not know where he will be sent, where his work will take him. He may have the thrilling experience of going to one of the great South American cities to put over some big project.

But it is by no means always so romantic. He is just as likely to be sent to some forsaken place down in Mexico, where the nearest railroad is 60 miles away and where a modern home would be as out of place as a kangaroo in a drawing room. Woe to the girl who wishes to establish herself and family in the life of a community, who aspires to social leadership, who despises packing up and moving on a three days' notice; who, in other words, hates change. Being the wife of an engineer just is not for her. But for one who can adjust herself to a variety of circumstances, there is a certain thrill in the precariousness of her husband's profession. She can face each new adventure with buoyancy and the thought that every new task is giving him experience, building for him that coveted reputation.

Should a girl marry an engineer? By all means—she will be marrying among the salt of the earth!

Alloy Materials
FOR BOILER SHELLS AND TUBES

By J. B. Romer and W. W. Eaton

Chief Chemist, The Babcock & Wilcox Co.

Sales Manager, The Babcock & Wilcox Tube Co.

How the strength, ductility, hardness and corrosive resistance of steel are affected by the addition of such elements as nickel, chromium, silicon, manganese, copper, tungsten cobalt and molybdenum, is told in this paper, presented at the Sixth Annual Meeting of the National Board of Boiler and Pressure Vessel Inspectors at Erie, Pa., on June 19.

IN THE early days, cast iron was quite generally employed in boiler construction. As pressures increased, low carbon or mild tough steel plates came into extensive use. What constitutes mild steel varies in different countries. Continental practice calls for a carbon content of 0.06 to 0.12 per cent, whereas in American practice a higher carbon, usually from 0.15 to 0.25 per cent, is employed. Cast iron is still used for non-pressure parts, including those that are subject to the action of hot gases. In the early constructions lap-welded charcoal iron tubes were principally used. These were being replaced slowly by lap-welded steel tubes, when seamless steel tubes entered the field, and the latter have become standard for all high pressure service. Seamless steel tubes usually have a carbon content of 0.08 to 0.18 per cent.

The higher and higher pressures and temperatures have involved additional manufacturing problems. As the temperature rose, other troubles were encountered, such as the loss of strength of the material and its tendency to oxidize and waste away. As a result, attention was turned to materials other than plain steel, particularly the alloy steels.

Although mild steel containing carbon and manganese is a true alloy, it is not customary to class it as such, and in this paper the term "alloy steel" will be used to signify ferrous alloys containing varying amounts of one or more of the alloying metals, nickel, chromium, silicon, manganese, vanadium, tungsten, copper, cobalt, molybdenum, etc. Each of these elements, when added to steel, alters one or more of its properties quite markedly.

Nickel, in small amounts, adds greatly to the strength and ductility of steel; it is also beneficial in reducing corrosion. In large amounts it is of increasing value in reducing oxidation.

Chromium adds strength and gives resistance to corrosion and oxidation.

Silicon, in small amounts, adds to the strength of the steel without much loss in ductility. It is used up to 3 to 5 per cent for its beneficial influence in reducing oxidation at elevated temperatures. For this reason it is frequently used in connection with other elements.

Manganese, although added to practically all steels, is not classed as an alloying element until it reaches at least 1 per cent. The effect of this element depends on the amount present. It confers strength and hardness and, under certain conditions, renders the steel quite brittle.

The greatest benefit of vanadium is as a deoxidizer and as a producer of smaller grain structure. For these purposes only a small amount is needed.

Tungsten is occasionally used to produce greater strength. The addition of tungsten is decidedly beneficial in preventing oxidation at high temperatures.

Copper is used to increase the resistance to corrosion.

Cobalt, although beneficial in reducing heat oxidation, is not extensively used because of its cost and the difficulty of working its alloys.

Molybdenum improves corrosion resistance, adds strength and toughness and tends to produce a better grain structure.

These remarks apply to cases where the resulting alloy is still strictly ferrous. Furthermore, the effect of these alloying elements depends upon the amount added, whether or not any other elements are present and whether the alloying elements form a solid solution with the iron. These factors are so important that it is necessary to study each individual alloy in order to know its characteristics.

A notable example of the use of alloy plates is the case of the Canadian Pacific Railway. C. S. McKnight, in his article, "Alloy Steel for Boiler Construction," published in the April, 1928, issue of the *Transactions of the American Society for Steel Treating*, mentions a number of isolated cases where 3 per cent nickel steel was used in constructing locomotive boilers. He then describes in detail the experience of the Canadian Pacific Railway with 44 locomotives, the boilers of which were constructed from 3 per cent nickel steel.

As brought out by McKnight, the use of 3 per cent nickel steel having a minimum tensile strength of 70,000 lb. per sq.in., permitted the Canadian Pacific Railway to increase the working pressure from 200 to 250 lb. per sq.in. without increasing the weight of the locomotives.

In view of the increased resistance to corrosion brought about by bad water conditions, as well as the resistance to service cracking between staybolt holes, so frequently met with in locomotive firebox sheets, the Canadian National Railway and other railroads have used 3 per cent

nickel steel for locomotive firebox sheets with excellent results.

Several American railroads are using with success the copper-molybdenum iron known as "Toncan" for locomotive tube sheets, side sheets and crown sheets, on account of the superior corrosion-resisting properties of this material.

High-pressure seamless drums are usually made of acid open-hearth steel which may be classed as a silicon alloy.

An alloy steel that is meeting with a great deal of favor is a 1.0-1.5 per cent nickel, 0.5-0.75 per cent chrome, steel sold under various trade names. This material is used widely in making studs and bolts for high-temperature, high-pressure service, as well as for safety-valve parts where a strong material, resistant to oxidation, is required.

Many fundamental points must be considered before an alloy can be adopted for any given service. Ultimate tensile strength, elastic limit, elongation and impact resistance over the entire range of temperature for which the material is being considered, must be known. As pointed out by Prof. F. C. Lee, the "creep stress" at the highest temperature at which the material is to be used must be determined.

The ease with which a material can be hot or cold worked and machined is important. A number of alloys that otherwise give an excellent account of themselves have a limited field because they can be used only in the cast condition.

For high-temperature service the scaling temperature of the alloy is also important.

Other properties that must be investigated are the thermal conductivity and the co-efficient of expansion. Where the material is to be subjected to elevated temperatures for long periods, it is essential to determine what, if any, changes occur in its structure or properties as a result of such heating. In many cases, the action of various gases and chemicals must also be studied before a new alloy can be accepted. Alloy materials fall into two groups:

1. Corrosion-resisting materials designed to withstand the effect of bad feed water or other corrosive influences.

2. Heat-resisting materials designed to withstand the high temperatures incident to modern high-pressure operation.

A commercial material of the first class is the so-called "Toncan" iron already referred to. This is a highly refined iron, with which are alloyed not less than 0.40 per cent copper and 0.05 per cent molybdenum. It is well known that the addition of copper in small quantities to a ferrous material improves its corrosion-resisting properties, and the further addition of molybdenum, besides enhancing this improvement, benefits the grain structure and adds strength and toughness.

The physical properties of Toncan iron are similar to those of the best grade of low-carbon steel and are as follows: Ultimate strength, 52,000 lb. per sq.in.; yield point, 39,500 lb. per sq.in.; elongation in 2 in., 47.0 per cent. The effect of adding copper and molybdenum has been to increase the resistance to corrosion without appreciably altering such properties as thermal conductivity, co-efficient of expansion, physical properties, or ability to weld or to withstand the effects of hot or cold working.

Excellent results have been obtained by the use of Toncan iron tubes in railroad practice. While the use of this alloy is not a cure-all for all bad water conditions, it may be expected to give better results with a wide variety of corrosive feed waters.

Heat Resisting Alloys

The second group, heat-resisting alloys, is best represented by the chrome-nickel irons. Several of these, of approximately the same analyses and characteristics, are on the market today. Among them are:

1. Enduro 18-8, an alloy which is manufactured by the Central Alloy Steel Corporation.

2. Allegheny Metal, made by the Allegheny Steel Company.

3. Rezistal No. 2, made by the Crucible Steel Company of America.

4. Carpenter Stainless Steel No. 4, made by the Carpenter Steel Company.

The general type analysis of these chrome nickel irons is as follows:

Carbon	Under 0.20 Per Cent
Manganese	Under 0.50 Per Cent
Phosphorus	Under 0.03 Per Cent
Sulphur	Under 0.03 Per Cent
Silicon*	Under 0.50 Per Cent
Chromium	17.0–20.0 Per Cent
Nickel	7.0–10.0 Per Cent

* Rezistal No. 2 contains approximately 2.00 Per Cent of silicon.

The following physical characteristics of Enduro 18-8 may be taken as representative of the group:

	Hot Rolled	Annealed
Tensile strength, lb. per sq.in.	110,000	90,000
Yield point, lb. per sq.in.	82,000	35,000
Proportional limit, lb. per sq.in.	67,500	30,000
Elongation in 2 inches, per cent	36	61
Reduction of area, per cent	52	75
Brinell hardness	223	135
Rockwell hardness	B-95	B-85

The chrome-nickel-iron alloys are not as good heat conductors as low-carbon steel. Tests made at the Massachusetts Institute of Technology indicate that Enduro 18-8 has a thermal conductivity about 40 per cent that of carbon steel. The ability of these alloy tubes to conduct heat is, however, ample for all boiler and superheater purposes.

Tubes of chrome-nickel-iron alloys easily undergo the operations necessary for boiler work. They may be readily expanded, swaged or bent.

The essential qualities of the chrome-nickel-iron alloys are their resistance to oxidation and their ability to retain a sufficient strength at high temperatures. It is stated that Allegheny Metal, when heated in an oxidizing atmosphere for twelve hours at 1,600 deg. F., will lose but 0.38 per cent in weight and when at 1,700 deg. for the same time, will lose 0.53 per cent. In considering the strength of these alloys at high temperatures, it is neces-

A great deal of study has been given to many of these alloys, and in some cases, the properties are quite thoroughly understood. There is still a great deal of information and data needed before alloy drum plates can be considered a commercially accomplished fact. For this reason, the A.S.M.E. Boiler Code does not yet authorize the use of drum-plate material other than mild carbon steel.

sary to make a distinction between tensile strength as ordinarily obtained from pulling test specimens, and the so-called "creep" strength.

At elevated temperatures the strength of a given material varies with the rate at which the load is applied. If applied relatively quickly as in a testing machine, the strength is greater than is actually the case when the material is subjected to stress over a long time as in actual practice.

A tube that is sufficiently thick for a given pressure based on its short-time tensile strength at a given temperature, but not thick enough to bring the stress below the "creep point" would, if placed in a boiler or superheater and kept under pressure at that temperature for a long period, progressively stretch or "creep" until the wall became too thin to withstand the pressure, when the tube would fail.

The transverse stress due to the weight of superheater tubes often exceeds that due to the steam pressure, and in such a case there would be a gradual sagging of the tubes if the transverse stress exceeded the "creep point."

The chrome-nickel-iron alloys have a field of usefulness entirely outside boiler practice in offering remarkable resistance to various types of corrosion. In boiler practice their chief use, owing to their relatively high cost, is in high-pressure, high-temperature installations where ordinary steel will fail, owing to oxidation or to low strength.

Finding Ed

EXPERIENCE has taught the editor that the engineer is seldom to be found in the power house, his duties being so numerous in these days that he ranges over the whole factory. But, when the editor called on Ed ———, engineer of the W——— Chemical Company, he hardly expected that he would have any duties outside of the power house walls, the complications of chemical plant operation seeming to demand the special skill of the chemical engineer for plant service work.

"If you want to see Ed," said the gateman, "you might go down to the power house; but he's not likely to be there. They'll know where he is, though."

"I'll walk along with you," spoke up a man standing in the gatehouse, "I'm V———, the production superintendent, and I was just going down near there, anyway."

The editor had not expected to see the plant until after his call on Ed; but he saw it first. Ed was not in the power house, so his assistant suggested looking in at the repair shop. But he was not there, either. Department after department was visited, without encountering Ed. Finally, after the whole plant had been combed over, he was found in one of the production buildings, supervising changes in the process water supply.

Whereupon the editor revised his ideas of the functions of an engineer in a chemical plant. Just as are engineers in less technical industries, Ed was at least as familiar with the factory as with the power house.

Useful Notebook Data

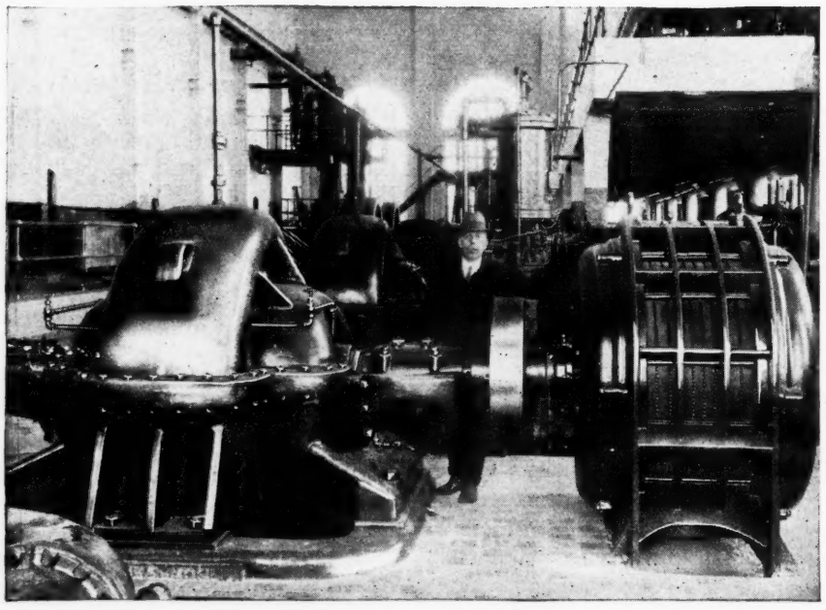
SOME BIDS RECEIVED RECENTLY BY THE CITY OF EVANSVILLE, IND., FOR STEAM ENGINES, GENERATORS, EXCITERS, CONDENSERS, AND SWITCHBOARD EQUIPMENT

Item	Murray Iron Works, Burlington, Ia.	Nordberg Mfg. Company Milwaukee, Wis.	Dravo-Doyle, Pittsburgh, Penna.	Swanson Elec. Co., Evansville	Skinner Eng. Erie, Penna.	Chuse Engine, Mattoon, Ill.	F. W. Wheeler, New York*
1. 250-kw. uniflow engine and generator with exc. and aux.	13,697.00	17,015.00	15,800 17,250	16,200.00	15,604.00	14,422 00	.....
2. 200-kw. uniflow engine and generator with exc. and aux.	12,004.00	15,180.00	13,000 15,800	14,848.00	14,296.00	11,607.00	.....
	25,701.00	32,195.00	28,800 33,050	31,046.00	29,900.00	26,029.00	.....
3. 560 sq.ft. surf. cond. and aux. for item (1)	.....	.....	3,500.00	3,800.00	.....	.....	3,760.00
4. 450 sq.ft. surf. cond. and aux. for item (2)	.....	.....	3,275.00	3,550.00	.....	.....	3,390.00
5. Furnishing and installing items 1, 2, 3 and 4	.....	.....	42,925.00 Ridgeway 38,800	42,411.00	.....	.....	.....
6. Moving present 75-kw. uniflow unit and furnishing new 75-kw. a.c. generator	.....	.....	4,225.00	3,800.00	.....	3,193.00	.....
7. Eight panel switchboard with equipment	.....	.....	4,715.00	4,462.00	.....	.....	.....
8. Furnishing and erecting switchboard equipment	.....	.....	5,800.00	5,860.00	.....	.....	.....
Total 5, 6 and 8	.....	.....	52,950.00 48,825.00	52,071.00			
Services of engineer for erection of							
Steam engine driven units	20.00	15.00	16.00	16.00	16.00	20.00	.....
Condensers	.....	.....	16.00	15.00	.....	.....	18.00
Switchboard	.....	.....	19.00	18.00	.....	.....	.....
Shipment after acceptance of proposal:							
(1) Engine driven units	70 da	4½ mo.	80 da.	70 da.	70 da.	65 da.	.....
(2) Condensers within	.....	.....	60 da.	70 da.	.....	.....	60 da.
(3) Switchboard—after date of signed contract	.....	.....	130 da.	70 da.	.....	.....	.....
Time from date of contr. for deliv. and erect.:							
(5) Within	70 da.	.....	150 da.	140 da.	3 mo.	45 da.	.....
(6) Within	.....	.....	90 da.	190 da.	.....	Item 6 tied	.....
(8) Within	.....	.....	160 da.	140 da.	.....	to 1 and 2	.....
				Deduct 400.00 from 5 and 6 for West. Add for G.E. Switchboard 920.00	Deduct 1. 200.00 2. 175.00 for West. Gen.		

Contract awarded to Swanson Elec. Co., Evansville, Ind.

* F.o.b. New York.

Steam Guarantees	Murray Iron Works, Burlington, Ia.		Nordberg Manuf. Co. Milwaukee		Dravo-Doyle, Pittsburgh	Dravo-Doyle, Pittsburgh		Skinner Eng., Erie, Pa.		Chuse Engine, Mattoon, Ill.	
	200	250	200	250	200	200	250	200	250	200	250
¾ load	29.0	28.2	29.0	28.8		29.8	29.3	28.9	28.3	31.5	31.0
½ load	25.0	24.2	24.0	23.8	Same	23.25	22.4	23.9	23.7	26.5	26.0
¼ load	23.6	22.9	23.5	23.4	as	22.4	22.0	23.7	23.4	24.8	24.4
Full	23.7	23.0	23.8	23.6	Skinner	23.6	22.6	24.6	24.4	24.8	24.4
1¼ load	24.3	23.6	25.5	25.3				26.3	25.9	25.8	25.4
Name of engine	Murray		Nordberg		Skinner	Ridgway		Skinner		Chuse	



Pumps driven by 600-horsepower squirrel-cage motors

Philadelphia Electrifies Torresdale Pumping Station

By changing from steam to motor-driven pumps, labor has been reduced from seventy to seven men and a total saving in operating costs of $150,000 per year is expected with the new equipment.

TORRESDALE pumping station of the city of Philadelphia, Pa., which supplies water from the Delaware River to filter beds, was built about 25 years ago and was equipped with seven steam-driven centrifugal pumps, each having a daily capacity of 40 million gallons. About two years ago it was decided to revamp the entire plant with new equipment to meet the future demands of the city. After a careful study of the various types of pumping equipment, motor-driven centrifugal pumps were selected as best suited to the plant's requirements.

Six centrifugal pumps, each having a rating of 50 million gallons per day against a head of 50 ft. were selected and installed. These are driven by 600-hp. 2,300-volt squirrel-cage motors equipped with self-aligning anti-friction bearings. The complete units were built by the Fairbanks Morse Company.

The specifications for the pumping equipment for this plant called for an average over-all efficiency from the busbars to the delivered water of not less than 76 per cent at full and at three-quarters rating. In order to meet this guarantee, it was necessary to built pumps and motors that would have an efficiency of about 83 and 92 per cent respectively.

When the units were placed on test they operated with efficiencies ranging from 77.3 on one up to 83.3 on the most efficient unit installed. The test curves for one of the units are shown in Fig. 2. For ratings above 46 million gallons per day the unit has an over-all efficiency above 80 per cent, and at a rating of 60 million gallons per day the efficiency is over 83 per cent.

The power factor of the motor is also high. Within the working range of the unit it is close to 87 per cent. On some of the other motors power factors of over 88 per cent are obtained. The specifications call for motors having a power factor of not less than 82 per cent at three-quarters and at full pump capacity. In case the power factor was below this figure on any motor, it might be accepted on the basis of a reduction of $500 in price of the motor for each one per cent below 82. In case the average power factor was below 78 per cent at the ratings mentioned, the motor would be rejected and would have to be replaced or altered to meet the specified requirements.

When selecting the type of motors to use on the pumps, the synchronous type was considered, but induction motors were selected. At that time it was decided to use

static condensers on the motors to correct the power factor if this were necessary. Owing to the high power factor of the motors and also because another pumping station will have synchronous-motor driven pumps and will be supplied from the same feeders as Torresdale, it has been possible to save the cost of the static condensers and meet the power-factor requirements of the power contract.

On test the units have delivered an average of 56 million gallons per day, or a total capacity of 324 million gallons per day. Thus the capacity of the motorized plant has been increased 20 per cent over that of the steam-driven plant. On one occasion when the plant was shut down completely for eighteen hours to make repairs on a distribution pipe line, the pumps were delivering at the rate of 300 million gallons per day in six minutes after all pumps were running.

This station, when steam driven, was operated with a total of 70 men. The motorized plant, with 20 per cent greater capacity, requires only seven men, two on each eight-hour shift and a chief engineer. It is expected that the new plant will save $150,000 per year.

The control for the motors, which was supplied by the Westinghouse Electric & Manufacturing Company, is located on a gallery on one side of the station, as shown in Fig. 1. Power is supplied for the operation of the plant by the Philadelphia Electric Company, through two 3,750-kva. 13,200- to 2,200-volt 60-cycle transformer banks. The circuit from the secondary side of the transformers is controlled directly by two feeder distribution panels in the switchboard, shown on the upper left of Fig. 1. On each of these panels is the lever for a 15,000-volt 1,200-ampere manually operated oil circuit breaker, overload relays and the necessary meters and instrument

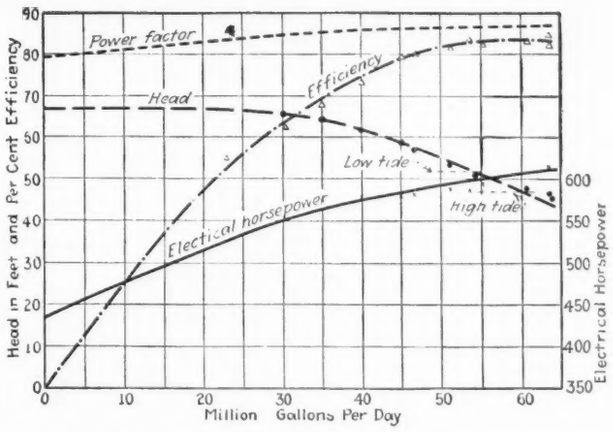


Fig. 2—Test curves from one of the pumps and motors

transformers. Power is fed through these breakers to a 2,300-volt running bus. A third panel in the switchboard is equipped with a 300-ampere manually operated oil circuit breaker, which supplies power at 1,500 volts to a common starting bus. This starting voltage is obtained by taking taps from the main transformer banks. A three-pole double-throw disconnect switch is provided so that the starting bus may be fed by either of the two transformer banks. Two other panels are for feeders for an additional 1,500-kw. load outside of the plant proper.

Twelve panels of the switchboard are for the motor controls. The equipment for starting each motor consists of a manually operated oil circuit breaker and two oil-immersed 2,300-volt magnet contactors, one for starting at 1,500 volts, the other for running at 2,300 volts. Disconnect switches are provided so that each motor can be entirely disconnected from the line. A 440-volt 60-cycle single-phase control circuit for actuating all the automatic starters is supplied by a 25-kva. 2,300- to 440-volt distribution transformer, with its primary

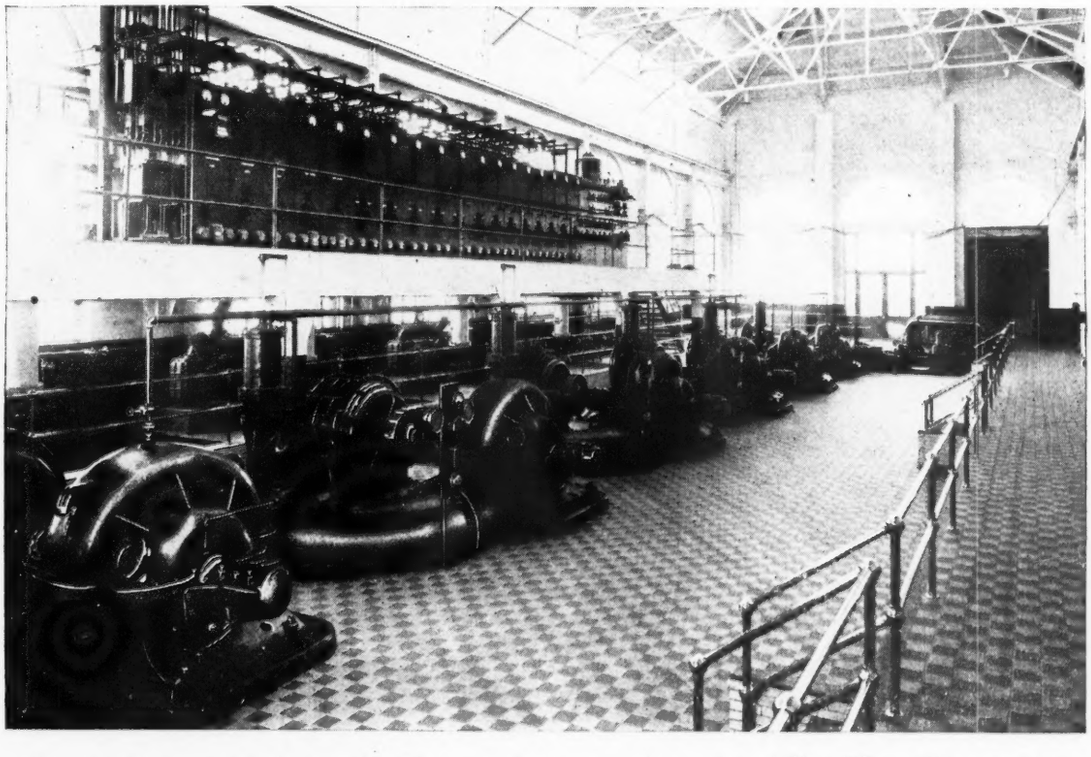


Fig. 1—Each of the six centrifugal pumps has a normal capacity of 50 million gallons per day against a 50-ft. head

windings connected directly to the 2,300-volt bus. A contactor, *x-y* Fig. 3, in the secondary of this transformer, has its operating coil connected in series with an auxiliary switch on the starting-busbar panel. This contact is open when the oil switch is open that connects the 1,500-volt starting busbar to the transformer. This feature, together with an auxiliary switch *B-2* on the manually operated breaker for each motor control, connected in series with relay *LV*, makes it impossible to actuate the control unless both starting and running busbars are energized.

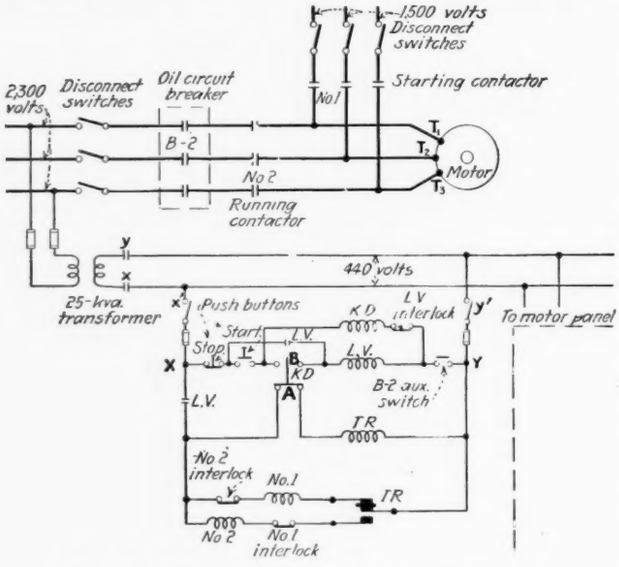


Fig. 3—Simplified diagram of control wiring for pump motors

The diagram, Fig. 3, shows the control employed for each motor starter. When conditions are correct for starting the motor, contacts *x-y* and auxiliary switch *B-2* are closed. Closing the start push button energizes the operating coil of the induction, geared, definite-time relay *KD*. This relay opens contacts *A* and closes contacts *B*, thus energizing control relay *LV*. Control relay *LV* on closing, completes the circuit to No. 1 starting contactor coil, makes its own holding circuit, and de-energizes the operating coil of *KD* timing relay.

The motor starts on 1,500 volts supplied through starting contactor No. 1. The contact disk on timing relay *KD* now descends by gravity, being retarded by the action of an aluminum disk rotating through the field of a strong permanent magnet. The timing can be made as high as 60 seconds by adjusting the position of the permanent magnet. The timing relay at the end of its travel energizes *TR* transfer relay coil, whose contacts open starting contactor No. 1 coil and close running contactor No. 2 coil circuit. Normally closed auxiliary contacts on contactors Nos. 1 and 2 serve to interlock them electrically so that it is impossible for both to be closed at the same time. Control actuating relays *KD, LV* and *TR* are mounted on the front of each starting panel protected by a dust-tight enclosure.

Overload protection for each motor is provided by overload relays operating in conjunction with direct-trip attachments on the *B-2* breaker. The 1,500-volt starting bus is likewise protected by overload relays. Low-voltage protection is provided by control relays *LV* which open the control circuit to the motor starters when the supply voltage drops below a predetermined value.

Torresdale Pumping Station supplies the city of Philadelphia with a large portion of its entire demand. It is imperative that all electrical equipment be of the highest order. The control equipment described in preceding paragraphs was designed on the basis of securing simplicity and reliability.

Power acknowledges with thanks the assistance rendered in the preparation of this article by R. W. Perry, Fairbanks Morse & Company; and F. N. Bell, Westinghouse Electric & Manufacturing Company.

Control Starts Machines in Proper Sequence

By J. J. Steinke
Electrical Engineer, Henry R. Kent & Co., Rutherford, N. J.

THE writer has read many articles on progressive machine control. Some were simple and others complicated, and with these frequently the true requirements were not met. To begin with, let us analyze the requirements of progressive machine control:

1. It should not be possible to start any machine in the circuit unless it is started in the proper sequence; that is, before a machine is started all machines that follow must be running and prepared to discharge whatever is forwarded to them.

2. It should be possible to stop quickly all the machines or any one of them instantly in case of emergency.

3. Whenever a machine in the circuit is stopped, all preceding machines should stop automatically, no matter if the stop is made manually by pressing a stop button, or is due to the overload trip. This arrangement is to avoid clogging of the system.

4. It should be possible to stop any machine in the circuit in the proper sequence, so that each machine may discharge its material before stopping.

The foregoing conditions can easily be met with nearly any modern magnetic control switch with overload relays and the proper push stations.

Fig. 1 shows an arrangement of a conveying control diagram, which is a typical case of progressive machinery. In most cases there is a belt conveyor over the coal bunker, an elevator to deliver the coal to the belt conveyor, a coal crusher, and an apron feeder to take the coal to the crusher. When found advisable, any num-

ber of other machines, such as automatic scales, magnetic separators, etc., can be inserted in sequence. In the figure the buttons marked emergency are simple stop buttons in series with the stop button in the last sequence, but placed in dangerous locations and marked emergency so that no one interferes with them except in emergency. These need only be plain push stations, except that in public places they should be of the break-glass type.

The stop push stations on the operating floor could be of the start and stop type, as shown by dotted lines in Fig. 2, provided all equipment is in sight of the operator. Otherwise, it is necessary to start the machinery at its point of application. In no case can the operator start or stop any machine out of its proper sequence. However, should an overload relay function and stop a certain machine, all preceding machines will stop automatically.

Before proceeding with explaining Fig. 2, it is necessary to know more about the controller. In this case automatic starting compensators are employed on all motors above 5 hp., because standard squirrel-cage motors were used.

Referring to Fig. 2, which is a simplified diagram of the control circuits Fig. 1, it will be noticed that all control circuits are open excepting at the belt conveyor. By pressing No. 4 start button, a circuit is made through the starting coil of the automatic compensator and the

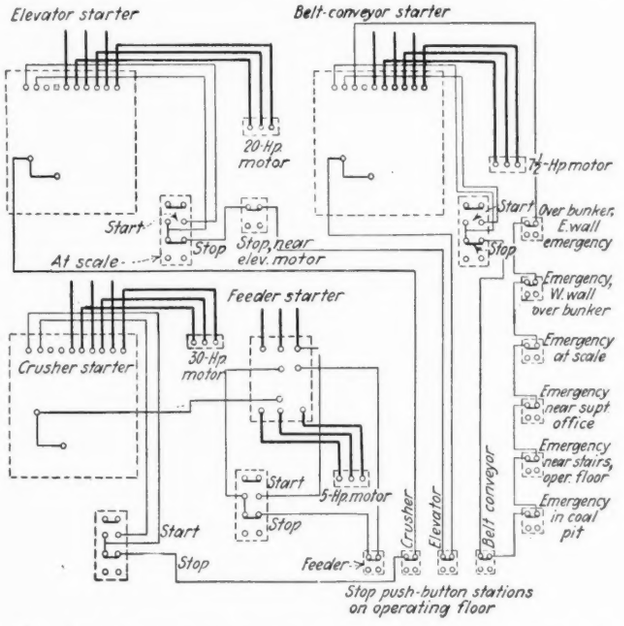


Fig. 1—Diagram of controller connections for a crusher and conveyor system

The arrangement of control connections is such that each machine must be started in its proper sequence and if any machine is stopped all preceding machines stop, thus preventing the piling up of material.

emergency stations. After acceleration of the motor the automatic compensator comes to the running position, closes the accelerating relay contacts and electrifies point 4 up to push button No. 3. By pressing the No. 3 start button, the circuits are completed through the same series of operations as for No. 4 and the control circuit made up to push station No. 2. By repeating the operation at stations No. 2 and No. 1, all machines are put in operation in their proper sequence.

Should one or more of the machines be started and trouble develop, by pushing any emergency station all these machines will stop. All machines will have to be started again in the proper sequence after the trouble is cleared.

If machine No. 3 is stopped, manually or automatically, machines Nos. 1 and 2 will also stop, thus stopping all material to machine No. 3, while No. 4 machine can

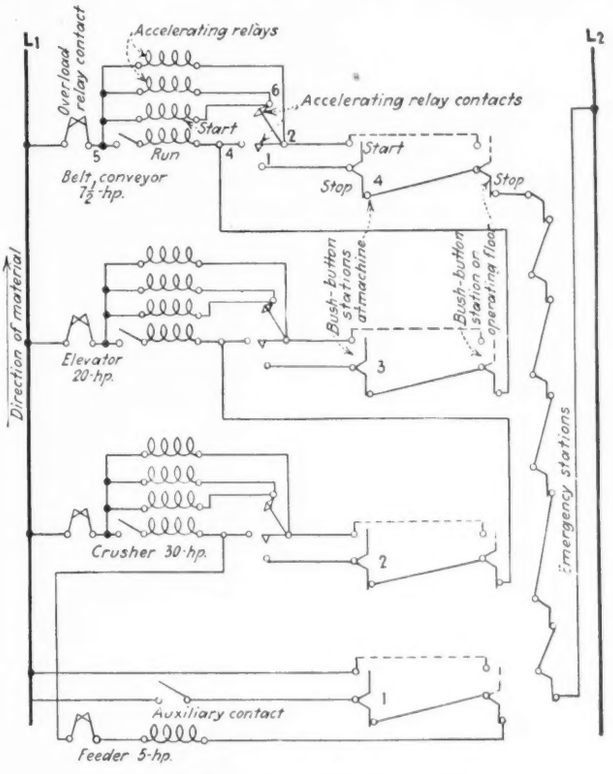


Fig. 2—Simplified diagram of Fig. 1

The first machine that can be started is the belt conveyor by closing start button No. 4. After the conveyor motor has come up to speed, the elevator motor can be started, followed by the crusher motor, and then the feeder motor may be brought into service.

discharge its material before it is stopped and will not have to be started with a full load.

Should machine No. 1 be stopped, manually or automatically, then Nos. 2, 3 and 4 can be stopped in the proper sequence after each has disposed of its material.

Normally, when stopping the plant it is good practice to stop machine No. 1, allow No. 2 to discharge its load and stop, etc. This makes it possible to start the motors again with light load.

As stated in a previous paragraph, where standard squirrel-cage motors are used, it is advisable to use automatic starting compensators on all sizes above 5 hp. On standard squirrel-cage motors of 5-hp. capacity or less, on larger motors with high-reactance stators, on high-resistance rotors or a combination of both, magnetic switches with overload relays may be used, which allows the use of more simple control equipment.

Although a typical control for coal-handling machinery has been discussed, the general principles are equally applicable to conveying and assembling machinery in manufacturing and assembling plants. In these plants, means for preventing material piling up in case one section of the conveying system stops is even more important than in a coal-handling system. If packages pile up there is the possibility that goods will be damaged and this must be guarded against.

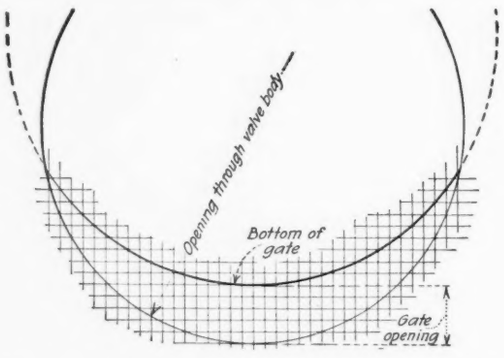
Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Method for Quickly Computing Area of Irregular Shapes

SOME time ago I was called upon to determine the area of the opening in a partly open 12-in. gate valve. The actual calculation of this lunar area involved more mathematics than I could remember and I had no planimeter. I used the following method for obtaining quick results.

I drew to scale upon cross-section paper of ten lines to the inch, circles of the body and the gate of the valve



Area is obtained by counting the squares and multiplying by the scale

in their proper positions for the desired opening. I then merely counted the number of whole squares that came in the area involved, multiplied this number by the ratio of the actual size of the valve to that drawn—that is, the scale—and the result was the actual opening.

In order to make the calculation more accurate, I also included in my count all the half-squares, doubling them to make full squares. The smaller the cross-section paper line spacing or the larger the scale used, the greater the accuracy.

I then calculated this area mathematically, and found an almost exact check, the actual difference being about 1 per cent. Later, I borrowed a planimeter and went over the scaled picture of the open area, and the results obtained checked in about the same percentage.

This method of finding the areas of irregular shapes has proved useful on several occasions recently, and one is not so liable to error as in mathematical calculations, planimeter settings, etc. L. G. JONES.

Pittsburgh, Pa.

Removing Oil from Process Steam

WHERE the steam going to an engine has afterward to be used for process work, it is quite important that the steam be as free from traces of oil as possible. A great deal of the oil used for cylinder lubrication is carried away in the exhaust steam, and if an excessive quantity is supplied, the steam may be rendered very greasy. In a recent instance the exhaust from a reciprocating engine was being used in the washing machines in a laundry, and owing to the presence of oil in the steam, the clothes were occasionally stained. Examination of the engine lubricating arrangements showed that a compounded cylinder oil was being used.

An oil separator had been originally fitted, but had failed to remove all the compounded oil. It was found that the oil existed as an emulsion in the steam, and oil in emulsion is difficult to remove. It was decided to use a high-grade straight-mineral oil and to feed this oil in the smallest possible amount, through a mechanical lubricator.

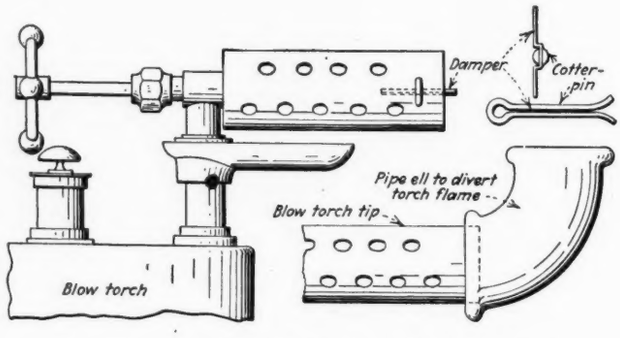
After these alterations were made, the steam was free from oil, and no further complaints were received from the laundry.

A straight mineral oil exists in suspension, and this is much easier to remove and there is no difficulty in removing every trace. This points to the fact that where steam free from oil is required, the kind of oil should be used. If oil is in suspension in the steam an oil separator is efficient, but when the oil is an emulsion the separator is only partly efficient. W. E. WARNER.

Brentford, England.

Practical Attachments for Blowtorch

IT IS possible to improve the operation of the standard blowtorch by using the simple attachments shown in the illustration. When a torch is turned low, it will sputter and get cold, possibly going out altogether. To avoid this, a damper put into the end of the burner as shown, will conserve the heat and the torch will be ready



Damper and flame deflector applied to torch

for instant use. The damper is made from a piece of sheet iron, cut oval, bent to shape and size of the burner. The damper is turned open or closed, by the cotter pin, which engages the bent portion of the shutter and is placed through opposite holes in the end of the burner.

The other improvement is the use of an ordinary pipe ell over the end of the burner, to divert the flame upward or downward, depending upon the kind of work being done. This device is handy when the torch can be placed adjacent to a job and the flame directed to the work.

Washington, D. C. GEORGE A. LUERS.

Plant Layout Diagrams Save Money

WHENEVER a power plant loses one of its operating staff, an expense is incurred in breaking in a new man for the place. The stranger is unfamiliar with the plant and its operating conditions. Someone must show him the "ropes" and explain his new duties.

There is also the possibility of a shutdown or other costly break in the routine, caused by the green hand. Experience proves that it takes an average of about five weeks' training before a new engineer can be safely left alone in his duties.

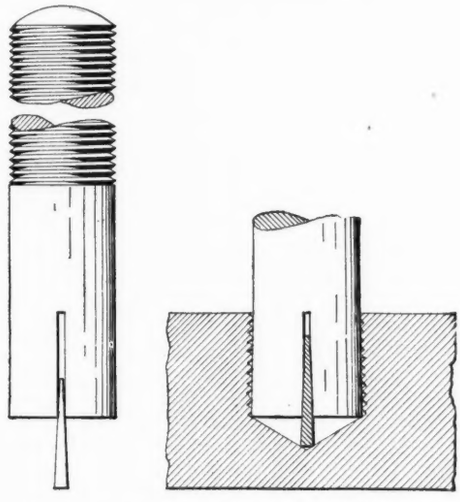
The engineering department of the American Optical Company's plant at Southbridge, Mass., has found that a complete diagrammatic layout of the plant saves much of the cost of this breaking-in process. In fact, it reduces this expense by about one-half. By its aid the new man can quickly see all the lines of flow of the power-plant products and raw materials, and the time of instructing him is greatly reduced. The diagram is more helpful if the pipe lines appear on it colored as they are actually in the plant. H. E. HILL.

Southbridge, Mass.

How the Bearing Studs Were Held in Place Temporarily

THERE are times when engineers have to devise ways and means of keeping a plant running owing to the absence of spare equipment or repair parts, and it occurred to me that the method we employed of holding bearing studs in place after the thread had been stripped, might be helpful to other readers in an emergency.

While I was engaged as an engineer on board a steamer, the bilge pumps became choked and we had to



Bearing studs held in place by wedge

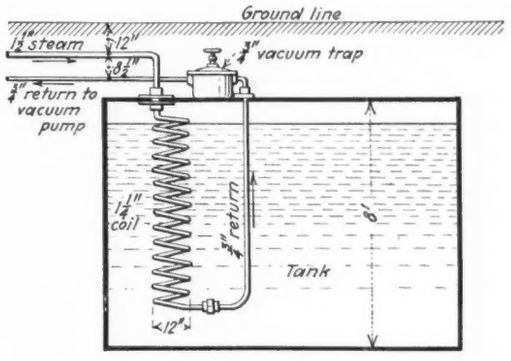
use the ballast pump. After the pump had been working a short time, for some reason the studs holding one of the pump bearings gave way, throwing it out of service. As we had no spare studs large enough or taps to rethread the holes in the bearing, some means had to be devised for holding the studs without threading.

We procured two pieces of round barsteel of the proper length and cut a groove about $\frac{1}{16}$ in. wide and 1 in. deep in one end of each stud, then made two soft-iron wedges tapering from $\frac{1}{32}$ in. to $\frac{3}{16}$ in. in thickness. When the part had been heated to a white heat, the wedges were inserted in the grooves and the studs put in place by hammering them down with a block of copper between the stud and the hammer. When the studs reached the bottom of the hole, the ends were expanded, as shown by the illustration, and they held the bearing securely until we got into port. C. FLANDERS SMITH.

Riverbend, Que., Canada.

How the Circulation in an Oil Heating Coil Was Remedied

IN THE fuel-oil practice for industrial plants, it is customary to use heating coils in the tanks, particularly when heavy-grade oil (14 to 16 deg. Baumé) is used. At one of our installations we had a tank 8 ft.



Arrangement of coil and trap connections

deep buried in the ground between two adjacent buildings. The vacuum pump was at a level 4 ft. above the bottom of the tank in the boiler room, a considerable distance from the tank. We used a $1\frac{1}{2}$-in. coil with $1\frac{1}{2}$-in. supply and return pipes, which were at the same level.

When the steam was turned into the coil, the vacuum pump could not create circulation in the coil. After some consideration a steam trap was installed at the bottom of the coil in the tank. Still there was no circulation. Several experts were called in, and the various suggestions offered as to how the trouble could be overcome resulted in the following changes being made: The steam supply pipe was kept at $1\frac{1}{2}$-in. diameter, but the coil was made of $1\frac{1}{4}$-in. pipe. At the end of the coil the vertical line was made of $\frac{3}{4}$-in. pipe and was carried to a vacuum trap outside of the tank. From the trap a $\frac{3}{4}$-in. return pipe was carried to the main return connected to the vacuum pump. The steam line was placed $8\frac{1}{2}$ in. above the return.

When the steam was again turned on, a good circulation was obtained with 2 lb. pressure and 3 in. vacuum on the return line. IGNACIO IZSAK.

Chicago, Ill.

An Odd Place for a Light

THE other day I had occasion to cut a piece of brass plate, following a scriber line, and I hit upon a handy kink that may help others.

With the plate held vertical in the vise, it was not easy to see the scribed line until I put an electric extension light on the floor under the stool I was sitting on. This did the trick so perfectly that it seems to me worth while to pass the suggestion along.

New York City. JAMES A. HARRIS.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

Got His Start with the Edison Bipolar

IN LOOKING over the June 12 issue, I was much interested in the photograph on page 1081 of the old Edison bipolar dynamo. I wonder how many of our present power-plant men started in on just this kind of power-house equipment. The picture with Mr. Floyd at the machine calls to my mind my first introduction to a power house.

The plant was at McCook, Nebraska, and the equipment consisted of three return-tubular boilers, hand-fired, working at 90 lb. pressure. The boilers were equipped with ball-and-lever safety valves and were fed with a duplex pump working out of a hotwell. In the engine room we had three high-speed engines—one Armington & Sims, one New York Safety and one Ideal. Each engine had two flywheels and was connected to a bipolar dynamo with a long drive belt.

The dynamos were 110-volt shunt-wound machines. The switchboard consisted of 6-in. pine boards on which were mounted volt and ampere meters for each machine. The distribution system was three-wire 110 and 220 volts. We had two shifts of twelve hours each, the engineer doing everything from looking after the switchboard and engines to firing and wheeling out ashes.

Undoubtedly, many of the present readers of *Power,* like myself, started in the power-plant game with the old Edison bipolar. C. D. DONOVAN.

Elephant Butte, N. M.

* * * *

The Modern Workman Sees the World

I READ with much interest the editorial, "The modern Workman Sees the World," in the June 19 issue. There is another view of the subject that I should like to add to those expressed, in the editorial. Although it is true that the modern worker does not have a less intelligent view of the world than had his grandfather, his work has narrowed down to some more-or-less minute detail. The modern worker may have his automobile, radio, newspaper and movie, and his outlook on life may be broad, nevertheless the decadence of the modern workingman to the status of a machine is gradually becoming more evident.

Within this century the structure of the new industrial society has been constantly changing and is in a state of flux. Invention, the development of transportation and of education, have constantly increased human wants for manufactured products and increased the ability of the industrial world to satisfy these wants. The real change is found in the new status of the worker in industry. This developed from the transfer of skill which was involved in the introduction of the factory system. Although the individual is becoming little more than a cog in a great machine, he is able to comprehend its entirety and fix his place in it.

The transfer of skill due to the factory system has divorced the worker from direct interest in the final product and in the tools of production. It has also led to his loss of control over conditions of work.

Prior to the industrial revolution it was the worker who had the skill; now the skill is largely to be found in the machines. Prior to this time (the latter half of the Eighteenth Century) the machines were used to aid the worker in performing his task; now the worker aids the machine. The skill of the trade and the inventor has been transferred to the machines, and an operator with but little skill or training can be quickly taught to handle the machine and turn out the product.

Since transference of skill involves loss of earning power, it is not hard to account for workmen frequently opposing introduction of new machinery. The skilled worker often finds himself degraded to the level of unskilled boys and girls who can operate the machines.

However, the situation is not so dark as it appears. Large groups of workers are needed to produce the machines with which others work, and this, together with the general expansion of industry due to increased production, will afford increasing employment for skilled men.

Granting that the modern worker does see the world, nevertheless his place in the factory is gradually being usurped by labor-supplanting machinery.

Philadelphia, Pa. JOSEPH BELL.

* * * *

What Happens When Steam Comes in Contact With Large Surface of Cold Water

IN REPLY to J. J. Wynhoff's inquiry in the June 19 issue as to what happens when steam is turned into a large tank three-quarters full of water, as described in the March 20 issue, I am of the opinion that nothing of any serious consequence occurs if the steam is turned into an air space above the water body. There, however, must be excessive condensation on the upper water surface, but this would take place quietly rather than with the shock and noise produced when steam is introduced into a body of cold water.

I have seen this method of putting pressure on a body of water used with success under slightly different conditions, although I think it is not as efficient of steam as even the common duplex direct-acting pump. I might also point out similar uses such as steam-operated tilting traps; in fact, all traps to a greater or lesser extent, and certain types of hydraulic elevators use this principle, although a thin layer of oil is placed between the water and steam to reduce condensation of the latter. How about the pulsometer?

It is well known that water will not transmit heat downward through its body, hence the necessity of applying the steam and pressure above the water. For those so inclined I would like to suggest the simple experiment of constructing a similar apparatus out of a bottle, a two-holed cork and a few pieces of glass and rubber tubing together with a suitable steam supply, and finding out just what occurs with steam above cold water.

Billings, Mont. KENNETH R. GIDDINGS.

Combustion Control Formulas

THE several comments that have appeared in *Power* on the articles by E. A. Uehling, on "Combustion Control Formulas" have proved interesting to me.

The remarks by Mr. Edge in the April 24 issue, relative to the air-flow steam-flow method of combustion control are quite correct. Variables due to accumulation of soot and erratic feeding are set up, which tend to falsify the air-flow steam-flow readings. Where these variables are known, however, they do not necessarily mislead the operator. The most serious variable is soot accumulation, as this increases the apparent air flow and at the same time increases the flue-gas temperature. The obvious remedy for this is the use of soot blowers and flue-gas recording thermometers, which are, of course, always used in the better plants. The variable due to feed water can be taken care of by suitable feed-water regulators.

The air-flow steam-flow method, however, being indirect, does require that not only a careful initial test be made to determine the correct air-flow setting, but occasional tests should be made to check for any variable that might have been introduced after the initial test if a reasonable efficiency is to be maintained. The same remarks apply more or less to the CO_2 recorder method of combustion control. With either method, of course, a flue-gas recording thermometer is necessary, and this, together with a CO_2 recorder, will give an indication of the losses due to excess air and soot accumulation.

To determine, however, the percentage of CO_2 that will give the highest economy requires a careful initial test, and also frequent checks, just as with the air-flow and steam-flow method. The highest percentage of CO_2 is not always the most economical, as this depends entirely on the furnace design, the class of fuel and many other factors more or less variable. With bituminous coal, fuel oil or other like fuels, a method that has several advantages is the smoke-observation method. If smoke is being produced in any quantity, it is evidence of air deficiency or bad furnace conditions. If no smoke whatever is being produced, there is evidence of air in excess of the requirements. A light smoke indicates relatively good combustion. This is well known to many engineers using fuel oil, it being only necessary to adjust the air supply until a light haze is being produced, which indicates the best combustion conditions. With bituminous coal it is not quite so easy, nevertheless the rule holds good in this case also.

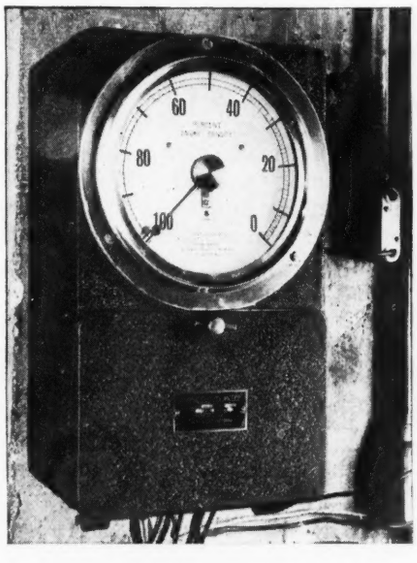


Fig. 1—Smoke-density meter of the indicating type

The difficulty of using the smoke method heretofore has been the absence of a reliable smoke meter and the consequent danger of transgressing the smoke ordinances.

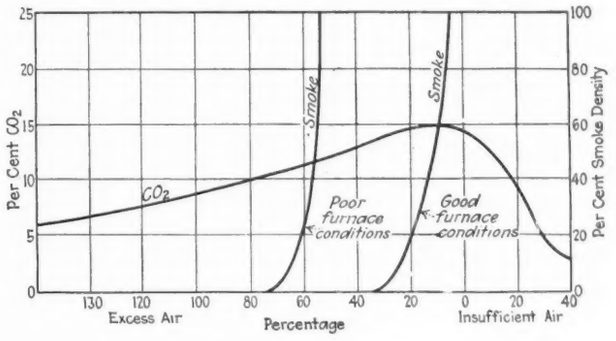


Fig. 2—Smoke-density and CO_2 curves

The smoke-density meter illustrated in Fig. 1 is an instrument that measures the actual percentage density of smoke. The use of this instrument, either with or without a CO_2 recorder, enables an operator to run a furnace at its most economical condition without the necessity of frequent Orsat tests.

It is usual to operate at a smoke density of about 5 to 10 per cent. At this density the smoke is almost invisible at the top of the stack, is quite permissible, and does not transgress any smoke ordinances. The smoke-density meter, either indicating or recording or both, together with a flue-gas thermometer, gives a direct check on both furnace and boiler conditions. The graph shown in Fig. 2 would indicate that the CO_2 curve bears no relation to the most economical conditions for any particular furnace, and shows that either a combined CO and CO_2 check is necessary, or a smoke-density meter, as the production of light smoke indicates the most economical condition that can be reached for any particular furnace.

FRANK SAWFORD.

Vancouver, B. C., Canada.

* * * *

A Reply to Gifford Pinchot

"ALL progress in American public affairs is promoted by public discussion and is based upon understanding." Constructive criticism should, therefore, be welcomed, but Gifford Pinchot's article in the June 5 issue of *Power* entitled "Propaganda in the Public Schools," hardly belongs in that category.

In the past the progress of public utilities has been handicapped by misunderstanding and wrong viewpoint, resulting in wrong attitude and lack of co-operation between these companies and the public.

Within a few years utility management has come to realize the seriousness of this situation and decided on a policy of improving public relations. The primary object was to locate and remove the causes of complaints and hostility among customers.

On the theory that every employee is a representative of his company and to some extent a salesman, the first step was to enlist the co-operation of employees.

They were and are coached in courtesy and in prompt and efficient handling of "trouble" and complaints, and trained men are at hand to inspect and adjust appliances and help the customer solve his lighting, heating, power or other problems relating to the service supplied, that the user may get the maximum of comfort and convenience for the money spent.

This policy has worked to the advantage of all concerned, except the habitual enemies of the privately owned public utilities. And, by the way, what about the 16,622,000 shares of electric utility stock now owned by customers and employees of these companies? As further proof that the new plan works, note the rapidly increasing "load" and extension of service into new territory. This is the basis, together with the high efficiency in construction and operation on which electric, gas and other utility service is being extended, even to small communities and rural districts, enabling these people to enjoy conveniences and comforts that formerly went with city life only.

If there ever was any general attitude of "the public be damned," the utility people are now "sold" on the idea that the public as a whole will play fair in a game it understands, and their chief concern so far as the public is concerned, is with the *understanding* of what the utilities are doing and trying to do.

This is their position: "The public utilities seek discussion of their affairs." "They have a record which will stand it, and the understanding which must result can only benefit them and the public they serve." "The utilities story is of interest to every element of the public." The utilities can and should tell the story. The utilities do not object to a fair investigation of their doings that will confine itself to complete facts, but those who rush out with the part of the story garnished with insinuations and surmises are a real menace to the public in general until such time as the whole story is known.

Ordinarily, political and government ownership controversies have been avoided in both speech and printed matter. Activities have been confined to talks by utility management and employees before all sorts of local organizations, including school assemblies. Some of these talks do not even deal with utility subjects. Others are in the nature of lectures on the history, development, production, distribution and use of electricity, gas, etc.

There is a standing invitation to students or anyone to visit utility plants. Classes in physics and chemistry frequently avail themselves of the privilege as a means of witnessing on a large scale the application of the principles found in the ordinary school textbooks.

Any literature we in this part of the United States know of having been furnished to the schools contains nothing more contaminating to the youthful mind than is found in the school textbooks. This is also the opinion of newspaper editors and others who have taken the trouble to procure and read this literature. Why it is any crime for a youngster to know something of the history of power development at Niagara Falls, how gas is produced and distributed or what is considered to be the future of these important factors in his or her life is not clear to an unprejudiced mind.

It certainly is hard to get the idea of why the "children" should not have a working knowledge of the history, production and use of commodities as important to their present and future welfare as those supplied by the public utilities, or why they shouldn't have a friendly attitude toward the people that supply these things. Perhaps that is why the utility people seem so dense to some folks in understanding and admitting the error of their way.

There are college men, astronomers, explorers, engineers, men in public life, and women too, who are specially fitted to deliver instructive lectures or to write on subjects of special or general interest, and who follow up this work as a business or side line. They have their price and get it. If one of these people has something that a public utility organization wants, why is it more scandalous to pay the fee for it than for a church or chamber of commerce to do the same?

Furthermore, if all the money spent in the United States per year by the electric power interest for publicity was divided pro rata, all hands could dress up, step out to the "five and ten" and "blow themselves" to ice cream cones. The public service commissions are not granting rate increases over night in order to tack these nickels on to the customer's bill either. A study made by the National Electric Light Association shows that the average domestic rate now is 15 per cent lower than in 1913.

Why shouldn't it be 100 per cent higher? About everything else is. No live utility wants a rate higher than consistent with maintaining an efficient system and making a fair profit, as high rates or even an increase in a low rate reflects unfavorably on sales. Earnings cannot be used in financing new developments. New capital must be procured for these after approval by the public service commission, and the expenditures are accounted for by the commission's system of bookkeeping.

Knowing some of these facts, the wild talk by utility enemies does not "check up." Also a very low estimate must be placed on the intelligence and horse sense of utility management in order to arrive at the conclusion that a concerted effort is being made to conceal a "nigger in the wood pile," who is bound eventually to be uncovered, to the undoing of all that years of effort has built up in gaining public confidence and good will. Furthermore, the utility people feel that their best defense against government ownership is public good will.

"Abe" Lincoln said, "You can fool all of the people some of the time and some of the people all of the time, but you can't fool all of the people all of the time." About the only difference now is that more of them are "from Missouri" and not so readily fooled any of the time. No one realizes this any better than utility management and employees, who are in contact with the public continually, therefore, what incentive, or, as a lawyer would say, what *motive* have they for this crime of which their enemies would be delighted to convict them?

Everyone who is familiar with the situation knows that the disturbance is gyrating around Muscle Shoals, the Boulder Dam scheme, the St. Lawrence River project and government ownership generally, and all hands should by now be quite familiar with the bag of tricks used by politicians to influence public opinion. Did it ever occur to you to consider the probable amount of public money that is spent by these people in one way and another to further their schemes and propaganda relating to government ownership? They are at it continually, but when the utility people go to the public with their side of the story and defend themselves, it is a crime against humanity.

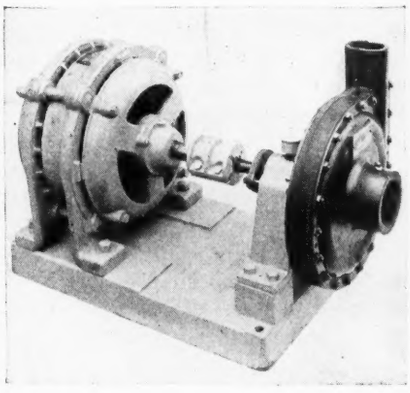
H. L. Strong,
Elmira, N. Y. Elmira Water, Light & R.R. Co.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Acid-Resisting Pump

A RECENT development in pumping equipment is a line of hard-rubber acid-resisting pumps, which has been developed by the Bingham Pump Company, Portland, Ore. These pumps are of the side-suction, inclosed impeller type, designed for high efficiency. The entire pump and impeller, with the exception of the shaft, which is made of Monel metal,



Acid-resisting pump of hard rubber

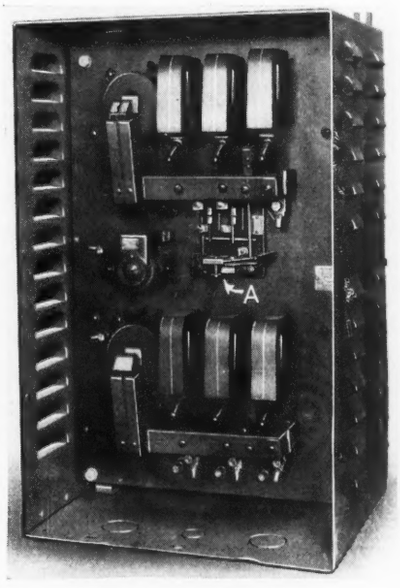
is of rubber molded from polished steel dies, which makes the pump capable of handling all acids except concentrated sulphuric acid.

One of the pumps of the series is shown in the illustration. Five sizes are manufactured, ranging in capacity from 50 to 300 gallons per minute.

Thermal Relays Give Overload Protection for Industrial Motors

A NEW thermal overload device, which retains calibration and automatically permits the safe overload capacity of the motor to be fully utilized, has been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This thermal device follows the heating curve of the motor, which means the motor will not shut down instantly in case of high, but harmless, overcurrent demands. The new unit is small and is shown at *A* in the figure.

Excessive current may or may not mean a motor overload. Heat in the motor winding does the damage and not the fact that the ammeter momentarily swings off scale. Motor temperature depends on the length of



Thermal overload relay installed at A

time the current flows, as well as on the amount of current. If either factor is small, the other can safely increase and the machine will have the same temperature. The mass of iron and copper gives thermal capacity to the motor and short high shots of current prove harmless because the generated heat is easily absorbed by the mass of relatively cool iron. The net result is a slight over-all increase in temperature. Continued high current is a different matter; the surrounding metal soon becomes saturated with heat and the machine temperature begins climbing rapidly.

The following relation between per cent load, time of tripping by the thermal relay, and maximum time for the motor to reach a dangerous temperature exists:

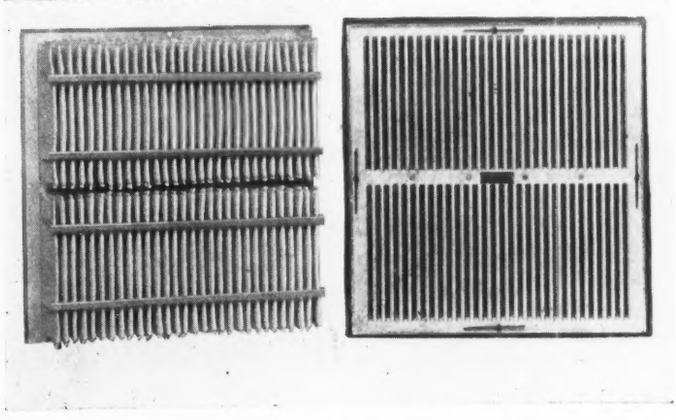
Load, Per Cent	Tripping Time, Minutes	Motor in Danger at End of Number of Minutes
150	2½	30
200	1½	9
300	⅔	3
600	⅙	¾

The heaters and bimetal work at 290 deg. F., making the matter of ambient temperature a negligible error. The relay is easily adjusted for plus or minus 20 per cent of normal rating, by moving a small lever.

Standard Panel Filter Units

THE illustration shows a type of filter designed for filtering large volumes of air for building ventilation and other services, recently introduced by the Staynew Filter Corporation, 95 North Water Street, Rochester, N. Y.

The filter panel consists of two pressed-steel or aluminum frames which support a series of hollow fins or pockets formed of wire cloth and arranged in two rows. Each row of fins is covered with a single piece of an extremely fine-texture filter mate-



Front and back views of filter panel

rial. The frame in which the panels are supported may be mounted in any convenient formation.

It is claimed by the manufacturers that this filter has an unusually high efficiency and that it can be operated under ordinary conditions for several months before cleaning is necessary. The filter can be cleaned by a special air suction cleaner by placing a special nozzle over the face of the panel where the openings into the sockets are located. The filter and frame assembled make a unit 20 in. square by $6\frac{5}{8}$ in. thick, having a capacity of 800 cu.ft. per minute.

Anthony Duplex Strainer

THE employment of a single shut-off valve to control the flow to both chambers and a blowdown arrangement for cleaning the baskets without removing them from the

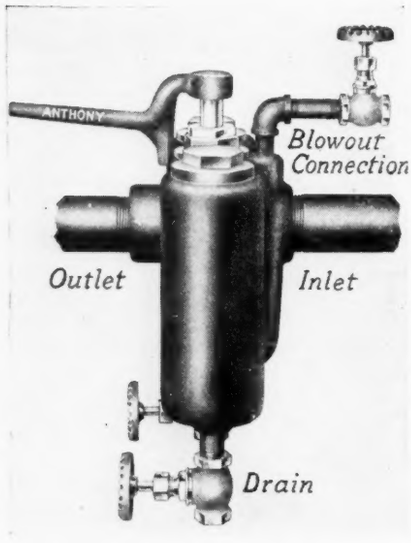


Fig. 1—Duplex strainer with blow-out connection

body are features of the duplex strainer recently introduced by the Anthony Company, 138 West Ave., Long Island City, N. Y.

Although developed primarily for oil-burning systems, the strainer, illustrated herewith, is adaptable to a variety of other services. It consists of two chambers in one body with central valve or quarter-turn cock for controlling the flow to each chamber. The direction of flow through the strainer baskets *A* is from the outside to the inside, so that the sediment or foreign matter collects in the chamber around the screen and is removed through a large drain connection on the bottom.

An important feature of the strainer is the provision for cleaning the baskets without removing them from the strainer body. This is accomplished by reversing the flow through the basket. A blowout connection at the top (see Fig. 1) is connected to a steam, compressed-air or water line as de-

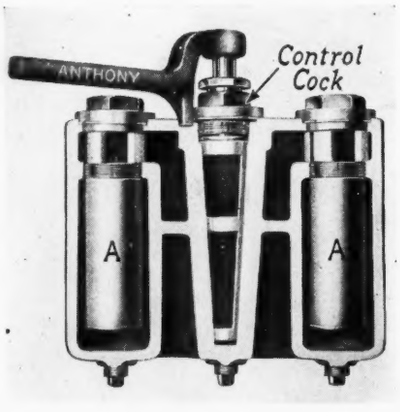


Fig. 2—Section through strainer

sired, and by moving the control cock to the off position for the chamber to be flushed or purged, it automatically connects the inside of the basket with the blowout connection. By turning the high-pressure steam, water or air into the inside of the basket, the obstruction on the exterior of the screen is blown free and washed out of the chamber through the drain.

The strainers are available in three sizes, $\frac{1}{2}$-, 2- and 4-in., suitable for pressures up to 250 lb. The bodies are of ferro steel and the baskets of perforated sheet brass.

King-Seeley Telegage

A TYPE of hydrostatic, distant reading liquid-level gage adapted to a variety of uses in the power and industrial plant field has been recently introduced by the King-Seeley Corporation, 312 Second St., Ann Arbor, Mich.

The gage is an adaptation of the telegage which the company has been supplying to the automotive industry for some years and is designed for such uses as checking and measuring the fuel-oil supply for oil-burning equipment and Diesel engines, brine supply in refrigerating plants, reservoir and penstock levels in hydroelectric plants, and similar services.

The gage operates on the simple hydrostatic principle of measuring the weight of liquid pressing down on an air bell. The air bell is placed at the bottom of the tank, and any increase or decrease in the depth of liquid changes the pressure on the air in the bell. This pressure is balanced against a heavy liquid in a direct reading U-tube gage placed at some convenient point adjacent to the tank, or a considerable distance from it as desired. The connection between the air bell *B* in the tank and the U-tube gage *C* is made through a small flexible copper tubing *D*, Fig. 2.

An important feature of the gage is the provision made for preventing the liquid from being drawn out of the U-gage and also for keeping the air bell full of air. In addition to the air line *D* running from the bell to the back half of the U-gage, a second line *E* returns from the top of the glass tube to the top of the

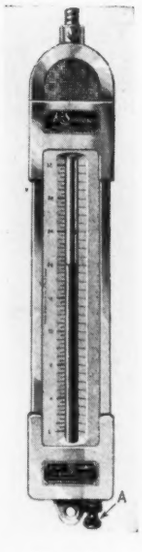


Fig. 1—U-gage

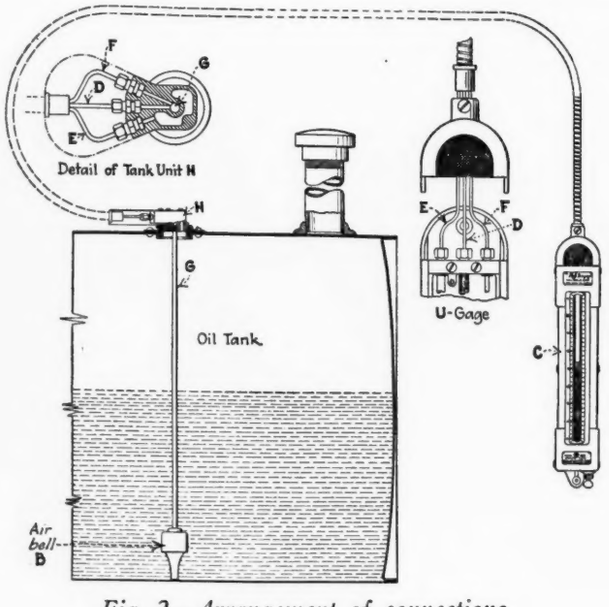


Fig. 2—Arrangement of connections between air bell and U-gage

tank. This equalizer line places the glass in a closed circuit and thus prevents the liquid from being blown from the tube or the contents being siphoned from it. For supplying air to the bell to replace any lost by absorption or temperature changes, a third line *F* carries air from a small pump in the side of the U-gage (see *A* Fig. 1) to the top of the air-tube gage. The three tubes which are of the same size are incased in a flexible metal conduit and are handled as one line.

To preclude the possibility of the tubes being connected wrong, they are fitted with different size fittings so that each tube will connect only to the right point. The dial of the U-gage is graduated in inches of depth and calibrated for the gravity of the liquid to be measured. Dials graduated in gallons, cubic feet or other units, can be furnished on request.

The gage is made in four models: A for measuring tanks up to 32 in. deep, B for tanks up to 66 in. C for tanks up to 11 ft., and D for greater depth.

Schaefer Bypass

WITH a view to simplifying the installation of the usual bypass on traps, reducing valves, pump governors and similar apparatus, the Frank H. Schaefer Company, La-

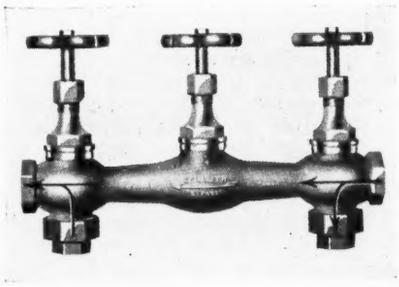


Fig. 1—Bypass with screwed ends and connecting unions

fayette Building, Philadelphia, Pa., has introduced the bypass assembly shown in Fig. 1. The bypass is made in the standard pattern for pressures up to 150 lb. and in the extra-heavy pattern for pressures from 150 to 300 lb.

It will be readily apparent that the bypass fitting, equipped with inlet, outlet and bypass valves, will not only conserve space and eliminate a number of screwed joints, but will give a much neater arrangement than when individual valves and connection are used.

The valves are of the globe pattern and are fitted with renewable seats and disks of either the flat or cone type. The disk holder is guided in the bonnet and is held on the stem by a collar, no nuts or pins being used. The holder permits inserting disks of various materials, such as

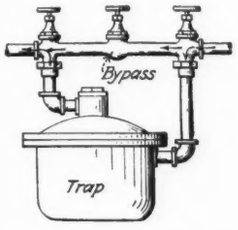


Fig. 2—Typical installation of bypass

copper, lead, leather, vulcanized composition, etc., to suit the service on which the bypass is to be used. The extra-heavy pattern is furnished with renewable seats of Monel metal.

The bypass is made in standard pipe sizes from ½- to 3-in. Fig. 2 shows a typical application of the bypass in connecting up a steam trap.

Zenith Fuel-Oil Filter

THE Zenith-Detroit Corporation, Mich., has recently introduced the small-sized, large-capacity, fuel-oil filter illustrated.

The filter, which is made in the single and duplex types, requires a comparatively small space (approxi-

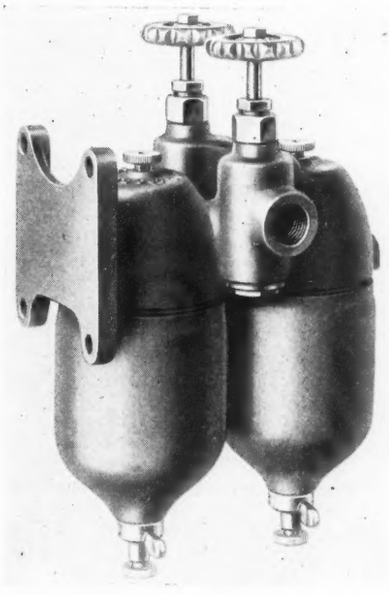


Fig. 1—Duplex unit with control valves

mately three-tenths of a cubic foot) and has capacity to filter sufficient oil of 21 deg. Baumé, at 60 deg. F. under 5 lb. pressure for a 1,000-hp. Diesel engine, or for a 4,000-hp. engine under 25 lb. pressure. The unit is designed to be attached to the engine frame and to be incorporated in the

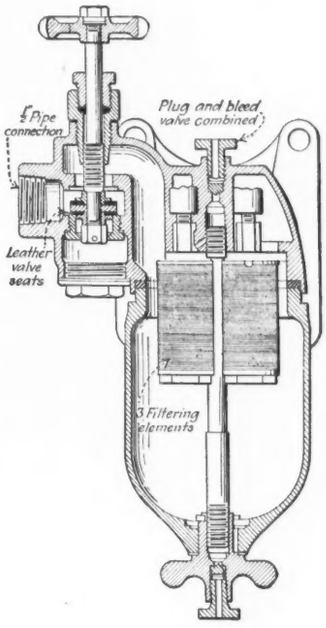


Fig. 2—Section through one control valve and filtering chamber of duplex unit

fuel supply between the oil tank and the engine pump.

The duplex unit consists of two filtering chambers with the control valves placed between them. The inlet connection is made to one of the valves and the outlet to the other. Each valve has a double seat and disk and is double-ported so that to cut out one element both valves are screwed up and for the other both valves are screwed down.

The filtering elements, of which there are three in each chamber, consist of a series of brass washers mounted on a spindle and separated by alternate spaces only 0.0035 in. thick. This provides a filtering space equivalent to 120-mesh wire screen but of much greater strength. The flow through the elements is from the outside to the inside, so that the sludge that collects on the outside is readily removed by dropping the lower part of the chamber or by opening the drain and back washing. The casing is held in place by a wing nut and can be readily tightened by hand without the use of tools. With the duplex type one side can be readily cleaned while running the other.

Preservation of Niagara Falls a Major Subject

At the Civil Engineers' Convention

WITH the Statler Hotel at Buffalo, N. Y., as headquarters, the American Society of Civil Engineers held its 58th Annual Convention, July 17 to 20. A major portion of the technical sessions was devoted to a discussion of the problems involved in the preservation of Niagara Falls; power development at the Falls; and the regulation of levels and navigation on the Great Lakes. That these were problems of vast importance to Canada and the United States was clearly brought out in the various papers and discussions.

In 1927 there was generated in the power plants at Niagara Falls 6,772,944,200 kilowatt-hours; over 2,000,000 people visit the Falls annually; and the freight movement on the Great Lakes amounts to about 90,000,000,000 ton-miles. Duluth, at the head of Lake Superior, is the second harbor in the United States in point of tonnage. Such figures as these leave little doubt as to the magnitude of the problem involved in dealing with these interests.

The session on the preservation of Niagara Falls was opened with a paper by Walter McCulloh, consulting engineer, Niagara Falls, N. Y., on "The Engineering Pioneers of the Niagara Frontier." Mr. McCulloh recounted the pioneer work and subsequent growth of navigation, transportation, bridges, water power, electricity, and electrochemistry, with which the Niagara River, its waters and power are so intimately associated. His talk was designed to lay the foundation for a better understanding of the geographic and scientific importance of the Niagara frontier.

Interim Report Presented

Following Mr. McCulloh's paper, Major Robert S. Thomas read the "Interim Report of the Special International Niagara Board on the Preservation of Niagara Falls." The board, after reviewing the conditions at the Falls, recession of the Horseshoe Falls, low lake stages, power diversion, preservation of scenic effects and remedial works, makes initial recommendations for preservation of the Falls. The report states that:

"The results to be anticipated from the construction of the works on the two flanks of the Horseshoe Falls will be the insurance at all seasons of an unbroken crest line from shore to shore, the maintenance of the present blended green and white color effects of the Horseshoe Falls and, in some proportionate measure, a modification of the rate of erosion in the bend. The works in Grass Island pool will insure an adequate flow in the American rapids and falls and between the Three Sister Islands.

Recommendations made for preventing erosion in the Horseshoe of the Canadian Falls and to test the effects of additional diversion for power development. Present water diversion from Niagara Falls develops nearly seven billion kilowatt-hours annually. A remarkably high over-all efficiency of over 84 per cent is obtained from intake to power lines. Power on the American side of the Falls is wholesaled at an average rate of 2.8 mills per kilowatt-hour.

"In respect to the sequence of construction of these works the board is of the opinion that the rewatering of the two bared flanks of the Horseshoe will be immediately productive in enhancing the values of the spectacle as a whole, and would, therefore, suggest that the first step to be initiated should be the construction of the works at the Canadian and American flanks of the Horseshoe falls. The second step in this initial work should be the placing of the upper weir."

Conclusions in Report

The estimated cost for these remedial works is placed at $1,750,000, after allowing 50 per cent increase for changes and contingencies. The board draws the following conclusions:

"The board is of the opinion that the early construction of the initial works is highly desirable. The bared flanks of the Horseshoe Falls have constituted the most striking and most obvious impairment of the scenic beauty of the spectacle, as a whole, for several years past. This impairment can be readily rectified, and the accomplishment of this will mean an early and most material enhancement of the present scenic beauty of the Falls. The subsequent early betterment of dependable flow over the American Falls, will add a further substantial measure of scenic beauty to the spectacle.

"In the interests of the more than 2,000,000 annual visitors to this scenic center it is most desirable that the measures for providing such a substantial betterment of the spectacle should be inaugurated at an early date. The construction of these initial works will furthermore, in some proportionate measure, modify the rate of erosion in the bend of the Horseshoe.

"A further and most important end, which this initial construction serves, is the opportunity afforded the two governments to actually test out in practice the effect of temporary additional withdrawals of water and the efficiency of remedial works to offset such withdrawals.

"Adequate facilities for additional water passage can be provided in the existing power stations on both sides of the river to permit of substantial additional withdrawals of water at such times and for such periods as will most effectively demonstrate the sufficiency of the remedial works to offset the same. No more effective demonstration is possible than that provided by direct observation on the Falls themselves.

"The board would therefore recommend that the construction of the initial works should be proceeded with at an early date."

Discussion on the Report

Dr. Julian C. Smith, president of the Engineering Institute of Canada, in a written discussion presented by J. B. Challies, paid high tribute to the Special International Niagara Board on the Preservation of Niagara Falls for its well co-ordinated investigation of the factors involved in the preservation of Niagara for both esthetic and utilitarian purposes. Doctor Smith's discussion then read in part:

"Perhaps nowhere else is there to be found a situation where commercial considerations are so far-reaching and

where at the same time esthetic interests are of such permanent importance.

"Whatever additional withdrawals may be permitted, extreme care must be exercised to insure that further works at the Falls and in the gorge below conform to such high standards of architectural treatment that the majesty and beauty of Niagara will not be marred.

"While the Niagara district may continue for many years to be the mecca of the engineer, bent upon studying the progress of hydro-electric practice on this continent, it might also well be an example for those seeking knowledge and inspiration for the proper treatment of monumental engineering works in important settings. Although excellent results have been achieved in this respect on both sides of the boundary, it is timely and appropriate that attention be focused upon the need of a comprehensive scheme for beautifying the whole Niagara Valley. The preservation of the beauty of the Falls both as to color and volume is a basic necessity, but it should be only the central motive of a major project embracing the district immediately contiguous to the whole river. The board's duties might therefore be extended to incorporate the evolution of a regional planning scheme which would contemplate the best use of all the falls and rapids of the Niagara River as a world-famous scenic spectacle, coupled with a complete study of ways and means for conserving the usable falls of the river between Lakes Erie and Ontario."

Remedial Work

How the initial remedial works recommended by the Special International Niagara Board could be constructed and their effects were explained by Oliver D. Dales, civil engineer in charge of construction projects of the Niagara Falls Power Company. Mr. Dales first called attention to the American Falls, which has a crest line of about 1,000 ft. which has, at mean flow of the river, about 9,000 sec.-ft. passing over it, or 9 sec.-ft. per lineal foot. There passes over the Horseshoe Falls at mean flow about 145,000 sec.-ft. For the first 950 ft. on the Goat Island end of the crest, there is a discharge of 10,000 sec.-ft. Under the present conditions, part of this crest section has no water flowing over it. By means of proper remedial works to distribute this water over the 950-ft. crest section would give an average of 10.5 sec.-ft. per lineal foot. On the first 450 ft. of the Canadian end of the crest there is a flow of 5,000 sec.-ft. with a considerable portion of this crest section devoid of water. Remedial works that would distribute this water over the 450-ft. crest section would give 11 sec.-ft. per lineal foot. These values of flow for the end crest sections of the Horseshoe Falls would then be greater per lineal foot than the present flow over the American Falls, and should give an effect equally pleasing.

Glenn C. Forrester, research chemist, Phosphorous Compounds Company, Niagara Falls, N. Y., reviewed the geological history of Niagara Falls.

Douglas Ellis, professor of civil engineering, Queens University, Kingston, Ontario, described the construction and operation of the model of Niagara Falls built by the Niagara Falls Power Company, to test the various remedial works and the effect of additional diversion of water for power development. This model is 110x120 ft. in horizontal dimensions, with a 4½-ft. fall.

Niagara Power

The development of power at Niagara has increased seven hundred times since the starting of the first commercial hydro-electric plant in 1881, according to Norman R. Gibson, vice-president and chief engineer of The Niagara Falls Power Company, who addressed the Powed Division meeting. Sketching the history of power development at Niagara. Mr. Gibson touched briefly upon the engineering characteristics of the many different power plants and indicated their steady evolution, synchronous with progress of the hydro-electrical art.

Fifty years ago the total use of Niagara approximated 2,000 hp. Today six major hydro-electric generating stations at Niagara Falls have a combined total installed capacity of more than 1,500,000 hp. power. Four of these power plants, with an aggregate capacity of 990,000 hp. are on the Canadian side of the Niagara River, and two, with an installation of 550,000 hp., are on the American side. The ownership and control of these six plants are vested in two organizations—the two American plants and one of the Canadian, in The Niagara Falls Power Company, and the other three Canadian plants in the Hydro-Electric Power Commission of Ontario.

Present Power Production

In the year 1927 these Niagara power plants produced, in round figures, 6,700,000,000 kw.-hr. of electrical energy. The average price paid by consumers of Niagara electrical service during 1926 was 9.2 mills a kilowatt-hour in western New York, and 9.2 mills a kilowatt-hour in southwestern Ontario. Giving effect to taxes paid by the producers, these figures become 8.1 mills in western New York and 9.1 mills in southwestern Ontario. The capital investment in power plants, transmission and distribution lines on the Canadian side of the Falls, in 1926, was $309 per kilowatt of installed capacity, compared to $267 on the New York side.

The further development of Niagara power service is restricted by the limitations imposed by the Boundary Waters treaty between the United States and Great Britain. Mr. Gibson reviewed the events leading up to this treaty, and explained the present unequal division of diverted waters, which permits the use of but 20,000 sec.-ft. on the American side, whereas 36,000 sec.-ft. is allowed on the Canadian side. Treaty restrictions limit the aggregate output of the Niagara power plants to an amount considerably below their installed capacities.

Mr. Gibson stated that extensive actual measurements have proved that diversions for power purposes at Niagara have not lowered the level of Lake Erie and pointed out that the proposals to regulate the level of Lake Erie in the interests of navigation would affect the regularity of flow in the Niagara River to such an extent as to cause a loss of usable power equal to 2,000,000,000 kw.-hr. per annum.

Quoting from many governmental and engineering reports, Mr. Gibson indicated that by giving effect to recommendations already made by responsible authorities, over double the present development at Niagara Falls can be accomplished without impairment of the scenic beauty of the Falls and River. It is not at all necessary now to decide how far power development ultimately may be carried, for the preservation of satisfactory scenic values may be ensured through the step-by-step development of power and scenery. The first step in that procedure is to carry out the recommendations of the Special International Niagara Board and progress the construction of the suggested remedial works—and then to construct a new power development on the American side under the full available head of 312 feet.

Niagara-Power Discussion

When discussing this paper, Thomas H. Hogg, chief hydraulic engineer, Hydro-Electric Power Commission of Ontario, agreed with Mr. Gibson's technical conclusions. The difference in capital costs for power developments on the two sides of the river, in the opinion of Mr. Hogg, was due to a wider distribution of power and the population not being so concentrated on the Canadian side of the river. Also the Queenston project, which is an overall development, involved higher cost per horsepower than for the older plants located at the Falls.

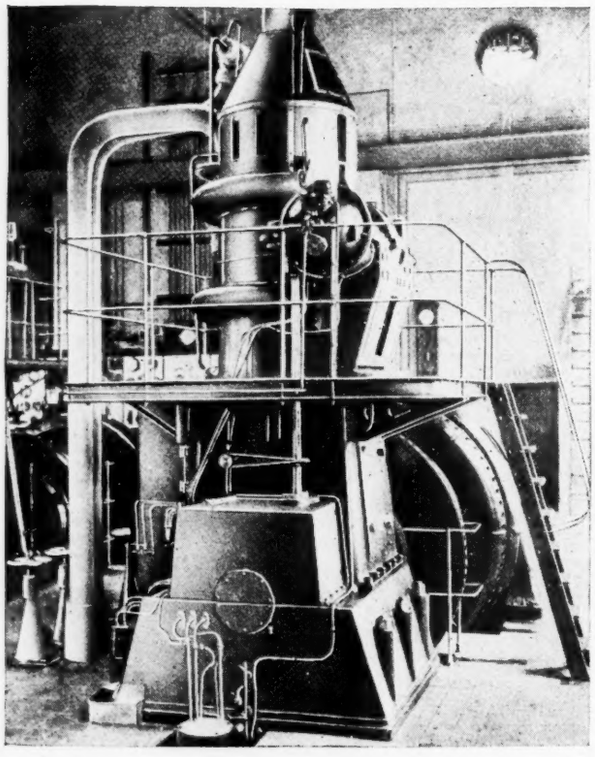
Others taking part in the discussion were Frank M. Williams, consulting engineer, Albany, N. Y.; Major Glen E. Edgerton, chief engineer, Federal Water Power Commission; Colonel Charles Keller, with the Byllesby Engineering Corporation, Chicago; and Colonel William Kelley, vice-president, Buffalo & Eastern Power Corporation, Buffalo, N. Y. Colonel Kelley said that over 84 per cent of the energy in the water diverted at Niagara Falls was delivered as electric power and that the power produced by The Niagara Falls Power Company is wholesaled at an average rate of 2.8 mills per kilowatt-hour.

Colonel Keller favors an ultimate diversion from the Falls of 100,000 sec.-ft., but he believes that an increase of more than 40,000 from the gorge would be detrimental to its ice-carrying capacity. Owing to the conformation of the region around the Niagara River, Colonel Keller believes that the greatest economy would result from developing the whole head in one plant on the New York side, if statesmen could be persuaded to agree to such an arrangement.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

First Demonstration of the 1,750-Lb. Loeffler Power Unit



THE first public demonstration of the high-pressure boiler and engine developed by Prof. S. Loeffler to furnish power to the Vienna Locomotive Works, took place on June 20, in the presence of Dr. Hainisch, president of Austria, and a delegation of engineers.

The vertical single-cylinder engine operating at 300 r.p.m. is direct connected to a 2,000-kw. generator. Steam at 1,764 lb. abs. pressure and 878 deg. F. temperature was supplied to the throttle. When operating against 176 lb. back pressure, a mean effective pressure of 579 lb. per sq.in. was obtained, exceeding that of a modern Diesel engine. Under these conditions the engine ran quietly and with remarkable smoothness.

Activities of Federal Power Commission

Surrender of its license by the Lockport and Newfane Mill Owners' Association has been accepted by the Federal Power Commission. This license covered the diversion of treaty water used on 18-Mile Creek. The water now is available for more efficient use in the plants of the Niagara Falls Power Company.

Under the new ruling of the Commission, however, the application of the Niagara Falls Power Company for an amendment to its license will not be laid before the Commission until complete agreement as to the costs involved will have been reached with the staff of the Commission. In the meantime the Niagara company may not utilize the water.

The Afton Electric Company, of Afton, Wyo., has applied for a license covering a small development on Swift Creek. The dam is to be 25 ft. high, creating a reservoir covering 13 acres in Swift Creek Canyon.

The Bedford Pulp & Paper Company of Bedford, Va., has applied to the commission for a license to build a dam and power house on the James River near Snowden, Amherst County, Va., to replace the old Cushaw Dam. The proposed dam would back water up the river approximately 1½ miles. The installed capacity of the project is estimated at 5,000 hp., which will be used by the company in the manufacture of pulp and paper.

That portion of the public that is favorable to the proposed power development at Cumberland Falls, Ky., is now beginning to take a more active interest in the matter. The application for license covering this project was filed more than two years ago. Propaganda against the project, alleging that the scenic beauty of the falls would be marred, was widely conducted. The army engineers, after a careful examination, recommended the granting of the license under conditions which would allow enough water to pass over the falls at all times to preserve its beauty. Those interested in the project expect early action, as the applicant has recently been called upon for a statement of all pre-license costs.

Recent Tests Show Scope of Illinois Superpower Systems

Recent tests of a new high-voltage electric substation, constructed at Kewanee, Ill., by the Illinois Power & Light Corporation, interconnected the electric supply systems of Chicago and St. Louis for the first time. The experiment showed the possibility of joining the power supply systems of these cities with those of other regions—south to the Gulf and east to Boston.

Normally, this city will be supplied with electricity transmitted over a high-voltage line from the hydro-electric plant at Keokuk. When the success of power transmission from this source had been proved, the engineers conducting the experiment disconnected the Keokuk plant and drew current from the Public Service Company of Northern Illinois, which company's lines are joined with those of the Commonwealth Edison Company, which supplies electric energy to Chicago, the two companies operating as a unit with other companies in Illinois and in Indiana, Ohio and Michigan.

Keokuk and St. Louis were then added to the circuit, and for the duration of the experiment the transmission lines and generating stations of several companies under different ownership and managements operated as one system. During the "big hook-up" electric lines in Missouri, and in Illinois south to Cairo and east to the Ohio river, including the central and northern portions of the state, were added to the gigantic power pool.

During normal operation there is little demand for these extensive "hook-ups," the engineers stated, pointing out

that there is a limit to the distance—roughly 250 miles—that electricity can be transmitted commercially. The importance of the possibility of extensive interconnection is the insurance against failure of a power supply in an emergency, explaining that each of several systems can furnish a disabled region with some power, the aggregate meeting the emergency demand.

Sale of Steel Boilers Increases During June

Statistics compiled by the Department of Commerce from 72 manufacturers of steel boilers, comprising most of the leading firms in the industry, indicate a trend toward increased sales of steel boilers. During June new orders were placed for 1,609 boilers, as compared with 1,571 in May, 1,325 in April and 1,247 in March. The square feet of boiler surface sold in June was 1,467,281, which is greater than the surface sold in June, 1927, by 100,795 sq.ft.

During the first six months of this year 7,780 boilers have been sold, totaling 7,592,628 sq.ft. of heating surface, while in the first six months of 1927 8,042 boilers were sold, representing 8,272,957 sq.ft. of heating surface.

Of the boiler surface sold in the first half of this year 46 per cent was in water-tube boilers, 30 per cent was in heating boilers as differentiated from power boilers, and 10 per cent in horizontal return-tubular boilers.

City of Philadelphia Orders Large Synchronous Motors

The City of Philadelphia recently placed an order with the Westinghouse Electric & Manufacturing Company for three large synchronous motors, including switching equipment, to be used in driving Fairbanks-Morse centrifugal pumps in the Belmont Pumping Station of that city.

Two of the motors ordered are 3,800 hp., 100 per cent power factor, 13,200-volt three-phase eight-pole 60-cycle coupled type with direct-connected exciters, running at 900 r.p.m. The third is a 1,725-hp. motor of the same rating and construction, running at 600 r.p.m.

The motor frames will be of the latest design, using electric arc-welded fabricated steel construction.

Truck-type switching equipment and closed-circuit reactor-type starting will be used.

James E. Denton, Professor of Engineering Practice, Dies

James Edgar Denton, professor emeritus of Stevens Institute of Technology, died at his home on July 22 after many years of illness.

He was born in 1855 at Piermont, New York, and after attending a Jersey City public school, entered Stevens Institute in 1871 as a member of its first regular class. After graduation in 1875 he entered the personal service of Professor Thurston to take charge of the testing work then carried on as a separate department in the Institute.

Between 1882 and 1886 Mr. Denton became engaged in the manufacture of rock-drilling machinery, and from this was led to engage in the construction of the Croton Aqueduct tunnel, about three miles of which was constructed under his direction and with drills of his own construction. During this period he divided his time between his engineering business and supervision of experimental instruction in the Institute.

During the management of the department of Experimental Mechanics he became associated with Dr. D. S. Jacobus, and together they developed its resources until 1898, when Professor Denton succeeded to the Chair of Mechanical Engineering. While active at Stevens he carried on a large amount of technical work for the general public, important examples of which are experiments with ammonia refrigeration machinery of the compression type, investigation of the mechanical properties of lubricants, and tests of a Curtiss steam turbine to determine its economy by a new principle for absorbing-dynamometers.

Professor Denton was a life member of the American Society of Mechanical Engineers, a member of the American Institute of Electrical Engineers, American Institute of Mining Engineers, American Society of Civil Engineers, Society for the Promotion of Engineering Education and honorary member of the Engineers' Club of New York.

Plans For London Fuel Conference Advance

American Delegates Selected—Authors of Many American and English Papers Announced—Delegates to London Fuel Conference Selected

SEVEN of the ten official delegates who will represent the United States Fuel Conference to be held in London, Sept. 24 to Oct. 26, under the auspices of the World Power Conference, have been chosen as follows: Dr. Gustav Egloff, petroleum technologist, Universal Oil Products Company, Chicago, Ill.; H. W. Brooks, consulting engineer, New York City, representing American Society of Mechanical Engineers and the International Railway Fuel Association; O. P. Hood, chief, technological branch, U. S. Bureau of Mines, Washington, D. C., representing American Society of Mechanical Engineers; Martin Frisch, manager of field engineering, Combustion Engineering Corporation, New York City; G. A. Orrok, consulting engineer, New York City, representing American Society of Mechanical Engineers; David B. Rushmore, formerly consulting engineer, General Electric Company, New York City, member of the executive committee, American committee; O. C. Merrill, general chairman, American committee, World Power Conference.

The program of technical papers to be presented by the various American engineering groups, as well as the English engineers, is nearing completion, and includes the following:

U. S. Bureau of Mines, Anthracite Substitute—Production of Solid Smokeless Fuels Whether by Means of Low Temperature Carbonization or by Means of an Improved Coke, G. G. Tryon, Washington, D. C.; American Institute of Mining and Metallurgical Engineers; Pulverized Fuel for Steam Purposes, Martin Frisch and Henry Kreisinger, Combustion Engineering Corporation, New York City; Pulverized Fuel and Metallurgical Work; W. O. Renkin, Fuller-Lehigh Company, Fullerton, Pa.; Pulverized Fuel in Marine Work; H. W. Brooks, consulting engineer, New York City; U. S. Bureau of Mines, Domestic Heating by Means of Solid Fuel, Oil, Gas, and Electricity, O. P. Hood, Washington, D. C.; National Electric Light Association, Domestic Heating by Means of Solid Fuel, Oil, Gas and Electricity, H. W. Derry, Union Gas and Electric Company, Cincinnati, Ohio; Utilization of Electricity for Industrial Heating, H. W. Sammis, Consumers Power Company, Jackson, Mich.; American Institute of Electrical Engineers, Utilization of Electricity for Industrial Heating.

Among the English papers to be presented are the following: The Storage and Handling of Solid Fuels by the User, R. K. Stockwell; The Technical Aspects of The Storage, Handling and Transmission of Liquid Fuels by The User, I. Lubbock; The Coking Industry as a Source of Industrial and Domestic Energy, and the Trend of Development, C. P. Finn and R. Ray; The Gas Industry as a Source of Domestic and Industrial Energy, F. W. Goodenough; The Utilization of Coke Oven Gas by The Gas Industry, T. P. Ridley; The Fundamental Aspects of Combustion, Professors W. A. Bone, G. I. Finch, and Dr. D. T. A. Townend; The Economic Utilization of Fuels in The Production of Electricity, R. P. Sloan; Fuel Oil For Steam Raising, Commander A. L. P. Mark-Wardlaw; The Industrial Heating by Solid, Liquid, and Gaseous Fuels, Sir Robert Hadfield and R. J. Sarjant; Industrial Electric Heating, S. E. Monkhouse; A Comparative Study of Solid Fuel, Gas, Electricity and Oil for Domestic Purposes, Dr. Margaret Fishenden; Pulverized Fuel Firing, F. H. Rosencrants; Fuel Oil for Heavy-Oil Engines, Harold Moore; Low-Temperature Carbonization, Dr. C. H. Lander and Dr. F. S. Sinnatt; Alcohol for Power Purposes, Col. Sir Frederic L. Nathan.

Sales of Mechanical Stokers Decrease

During June twelve leading manufacturers in the stoker industry reported to the Department of Commerce a total sale of 166 mechanical stokers to serve under 432,120 sq.ft. of boiler surface. While this represents an increase of 36 stokers over the previous month's sale, it is 17 stokers less than for June of last year. For the first six months of 1928 there have been reported 667 stokers sold, serving a total of 2,260,000 sq.ft. of boiler surface, which is 9.3 per cent less than the sales for the first six months of 1927. During last year there were sold 1,374 mechanical stokers serving a total of 4,836,020 sq.ft. of boiler surface.

New Engineering Organization Formed

The formation of the Stone & Webster Engineering Corporation, with a capitalization of $9,500,000, to take over the construction and engineering business of Stone & Webster, Inc., the engineering and construction organizations of McClellan & Junkersfeld, Inc., which was acquired from the North American Company, and the Uhlen Company, has been announced.

George Muhlfeld, formerly of Stone & Webster, Inc., is president of the new organization and W. McClelland and P. Junkersfeld are vice-presidents.

Stone & Webster, Inc., will continue as a separate organization and will carry on its management of utility properties as heretofore.

Professor Diedrichs Appointed to John E. Sweet Professorship

The first recipient of the newly established John E. Sweet professorship in mechanical engineering at Cornell University is Prof. Herman Diedrichs, director of the Sibley School of Mechanical Engineering. Professor Diedrichs was chosen for this honor after a nation-wide survey of outstanding engineeers.

The new professorship fund was raised at the instigation of alumni of Cornell who were former students, and friends of the late Professor Sweet, the first director of Sibley College. He was the organizing genius of the American Society of Mechanical Engineers, its second president and an honorary member in perpetuity.

Largest Saskatchewan Hydro Development Planned

Initial development of 39,000 hp. at Island Falls, on the Churchill River in the province of Saskatchewan, is announced by the Churchill River Power Company, Limited, which is allied with the Harry Payne Whitney interests in developing the Flin Flon Mining properties and which will supply hydroelectric power to the Flin Flon.

The Island Falls power plant will have a capacity larger than any now existing in the province of Saskatchewan. At present the City of Regina has the largest power plant, with 26,500 hp. Saskatchewan has large waterpower resources, especially in the northern section, where Island Falls is situated. On the Churchill River alone there are eight principal power sites in Saskatchewan and as many more in Manitoba, the potentialities in power development on this stream in the two provinces being rated at 700,000 to 800,000 horsepower.

Coming Conventions

American Society of Mechanical Engineers, Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 3-8. Address inquiries to the International Exposition Company, Grand Central Palace, New York City.

New England Water Works Association, annual convention at Montreal, Canada, Sept. 18-21, Frank J. Gifford, secretary, 715 Tremont Temple, Boston, Mass.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Universal Craftsmen Council of Engineers, annual convention and power engineering exhibition to be held at Newark, N. J., Aug. 7-10. Secretary, O. R. Young, 150 Nassau St., N. Y.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Dr. George F. Swain Awarded Benjamin G. Lamme Medal

The first award of the Benjamin G. Lamme gold medal "for accomplishment in technical teaching or actual advancement of the art of technical training" has been made to Dr. George Fillmore Swain, of Harvard.

Doctor Swain has attained distinction as a thorough and practical engineer, an inspiring teacher and an authoritative writer. He received his technical education at the Massachusetts Institute of Technology and the Royal Polytechnic School of Berlin. Honorary degrees have been granted to him by the New York University and the University of California.

In 1887 Doctor Swain started his teaching work at the Massachusetts Institute of Technology. Since 1909 he has been a distinguished member of the faculty of the Harvard Engineering School. He has served as a consulting engineer for the Massachusetts Railroad Commission and has been associated with a number of engineering enterprises.

The medal which has been awarded by the Society for the Promotion of Engineering Education was provided by the will of the late Benjamin G. Lamme, formerly chief engineer for the Westinghouse Electric & Manufacturing Company. It was Mr. Lamme's desire to advance the engineering profession by encouraging good technical teaching.

PERSONALS

J. M. BARRETT has resigned as vice-president and director of the Swartwout Company, Cleveland, Ohio. Mr. Barrett was general manager of the S. C. Regulator Manufacturing Company for 16 years before its consolidation with the Swartout Company.

HERBERT HOOVER has been awarded for 1927 the Major Surgeon Louis Livingston Seaman medal by the American Museum of Safety. This medal is for the best record in the saving of life in the field of sanitation and accidents and is awarded to Mr. Hoover in recognition of his "great public service from the standpoint of human values," and particularly for his "conspicuous work in the Mississippi flood relief." The most recent award of this medal was in 1922 to the late Judge Elbert H. Gary.

DR. JOHN JOHNSTON, director of research and technology of the United States Steel Corporation, C. A. Reinhardt, chief metallurgist of the Youngstown Sheet & Tube Company, Dr. A. J. Unger, manager of the research bureau of the Carnegie Steel Company, and Homer D. Williams, president of the Pittsburgh Steel Company, have been invited by President Thomas S. Baker to become members of the advisory board of the department of metallurgical engineering at Carnegie Institute of Technology. The advisory board, which is composed of about 25 steel company executives and metallurgists, is concerned primarily with the development of metallurgical research as now carried on jointly by the Carnegie Institute of Technology and the United State Bureau of Mines.

DAN BLANKENSHIP has been elected president of the Sioux City, Iowa, chapter of the National Association of Power Engineers, succeeding W. W. Gasser. Other officers for the year are: M. M. Umbarger, vice-president; C. H. Amos, corresponding secretary; Roy Heilman, secretary; Jack Schultz, financial secretary and O. Lindblade, trustee.

THOS. J. SULLIVAN and T. HAYDEN HAMILTON are now associated as consulting engineers in the industrial heat

and power field, with offices in the French Building, 551 Fifth Ave., New York City. Mr. Sullivan was formerly with the Nichols Copper Company as chief engineer and mechanical superintendent. Mr. Hamilton was with the Standard Oil Company of New Jersey, as research engineer and as chief engineer in charge of construction of the Bayton plant of the Humble Oil & Refining Company.

ROBERT L. SPENCER, formerly proposition engineer, Heine Boiler Company, New York, has resigned his position to join the faculty of the University of Delaware, Newark, Del., as dean of the College of Engineering.

T. W. FRECH, manager of the incandescent lamp department of the General Electric Company, was recently elected to the position of vice-president in charge of the incandescent lamp department, and Dr. W. R. Whitney, director of the research laboratory, was elected a vice-president of the company and director of research.

J. W. CLIFF has recently joined the MacGregor Valve Company, in St. Louis, as production manager.

BUSINESS NOTES

THE WAGNER ELECTRIC CORPORATION, St. Louis, Mo., announces that Fred Johnson, heretofore in charge of the St. Louis sales office, is now manager of the Los Angeles branch office, and that Alex L. Miltenberger, formerly Pacific Coast manager with headquarters in San Francisco, has been transferred to St. Louis as branch manager of the St. Louis office.

THE RILEY STOKER CORPORATION, Worcester, Mass., announces the appointment of L. E. Griffith, formerly district manager of New York office, as sales manager of the company to succeed William Pestell, deceased. W. L. Schultz succeeds Mr. Griffith as district manager of the New York office.

THE MURRAY IRON WORKS COMPANY, Burlington, Iowa, announces the appointment of the following district turbine sales managers: Fred H. Dorner, 311 Knapp St., Milwaukee, Wis.; Dennis Engineering Company, 243 N. High St., Columbus, Ohio; and Briggs Weaver Machinery Company, Dallas, Texas.

COMBUSTION ENGINEERING CORPORATION, 200 Madison Avenue, New York City, has appointed W. O. Rankin as manager of the industrial furnace department.

THE ELLIOTT COMPANY OF CALIFORNIA has recently been organized with headquarters at 813 Rialto Building, San Francisco, Calif. The officers of the new corporation are: W. S. Elliott, president; F. A. Calmus, vice-president and general manager; C. W. Moore, secretary and treasurer.

NORTHERN EQUIPMENT COMPANY, Erie, Pa., announces the appointment of Don Allshouse as advertising manager. Mr. Allshouse comes to the Copes organization from Lamport, MacDonald Company, South Bend, Ind. Prior to that, he was a member of the Department of Publicity of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THE BODINE ELECTRIC COMPANY, 2254 West Ohio St., Chicago, announces that H. D'Almaine has recently been appointed assistant sales manager. Mr. D'Almaine was formerly advertising manager of Louis Allis Company, of Milwaukee, Wis., and previous to that, assistant sales manager of Charles Cory & Son, Inc., New York.

THE ELLIOTT COMPANY OF CALIFORNIA has opened a district office in Los Angeles at 528 Security Building, 5th and Spring Sts. The office is in charge of W. A. S. Harmon, formerly mechanical engineer with the Department of Water and Power, City of Los Angeles.

GENERAL ELECTRIC sales billed for the first half of 1928 amounted to $158,015,221, compared with $149,795,026 for the corresponding period last year, president Gerard Swope has announced. Profit available for dividends on common stock for the first half of 1928 was $24,388,002, as compared with $22,542,972 for the corresponding six months of last year, is equivalent to $3.38 a share in 1928 and $3.13 a share in 1927.

TRADE CATALOGS

OXWELDING AND CUTTING EQUIPMENT—A new booklet entitled "Oxweld" has been issued by the Oxweld Acetylene Company, New York, in which the various products including welding and cutting equipment, generators and regulators, also the Carbic low-pressure generator and the Carbic flood light are described in detail.

COMPARATIVE COST OF POWER—A very fair comparison of the cost of power obtained from outside source, generated by steam engines or produced by oil engine is contained in Bulletin E-1 just issued by the Power Manufacturing Co., Marion, Ohio, builder of the Primm oil engine.

STEAM-ENGINE-DRIVEN GENERATING SETS FOR MARINE SERVICE—This bulletin of the General Electric Company, Schenectady, N. Y., has six pages describing small vertical steam-engine driven direct-current generators, for capacities up to 30 kw. at 110 to 125 volts.

CENTRIFUGAL PUMPS—This bulletin, published by the Ingersoll-Rand Company, covers the construction and application of multi-stage centrifugal pumps for boiler feeding, hydraulic service in steel mills and mine drainage. It contains 32 pages of colored illustration and descriptive material on the HMT and HST type centrifugal pumps.

STATION OIL CIRCUIT BREAKERS—This piece of literature of the General Electric Company, Schenectady, N. Y., contains 6 pages and gives the dimensions for types FK-330 and FHK-330 breakers mounted on channels in cells with the operating mechanisms in front.

ARC WELDING—Automatic Arc Welding by the Electronic Tornado Process is the name of a new bulletin issued by the Lincoln Electric Company, Cleveland, Ohio. The bulletin describes the new process of welding, which is known as the "Electronic Tornado" in all its phases, including a treatise on the advantages of the use of the carbon electrode for automatic arc welding. A description of the operation and a table showing the speed and costs of automatic arc welding of metal of different thicknesses for various joints, as well as illustration of welding machine showing actual applications of the new process, are included.

FLOOR AND ROOF DRAINS—A 72-page catalog published by the Josam Manufacturing Company, Michigan City, Ind., describes and illustrates the complete line of drain traps and steam water heaters manufactured by this company.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.35@$2.50
Kanawha	Columbus	1.25@1.60
Smokeless	Cincinnati	2.00@2.25
Smokeless	Chicago	1.75@2.00
S. E. Kentucky	Chicago	1.30@1.60
Steam	Pittsburgh	1.40@1.80
Gas Slack	Pittsburgh	1.10@1.20
Big Seam	Birmingham	1.25@1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.50@$3.00
Birdseye	New York	1.60

FUEL OIL

New York—July 26, f.o.b. Bayonne, N. J.: 28@34 deg., Baumé, industrial use, tank-car lots, 5c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal.

St. Louis—July 22, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.35 per bbl.; 26@28 deg., $1.40 per bbl.; 28@30 deg., $1.45 per bbl.; 30@32 deg., $1.50 per bbl.; 32@36 deg., gas oil, 4.15c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—July 17, f.o.b. local refinery, 30@34 deg., fuel oil, 5½c. per gal.; 36@40 deg., 5¾c. per gal.

Philadelphia—July 24, 26@30 deg., $2.00@$2.07 per bbl.; 13@19 deg., $1.05 @$1.12 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.10@$2.17 per bbl.

Cincinnati—July 23, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—July 21, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.: 22@26 deg., 60@62½c. per bbl.; 26@30 deg., 75@80c. per bbl.; 30@32 deg., 90@95c. per bbl.

Boston—July 24, tank-car lots, f.o.b. 12@14 deg. Baumé, 4¼c. per gal.; 28@32 deg., 5½c. per gal.

Dallas—July 21, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Mare Island—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the construction of an automatic refrigeration plant at Navy Yard here.

Ga., Barnesville—City, E. L. Coleman, mayor, awarded contract for waterworks improvements including filtration plant and raw water pumping station, etc. to Arthur Pew, Jr., 1020 Columbia St. N. E. Estimated cost $27,230.

Ill., Chicago—Bd. of Education, E. Withall, Bus. Mgr., will soon award contract for the construction of two junior high schools including steam heating and ventilating systems, heat regulation, coal and ash conveyor system, etc. at Long and Fullerton Sts. and 82nd and Essex Sts. Estimated cost $2,000,000 each.

Ill., Chicago—Chicago Stadium Corp., c/o P. T. Harmon, Paulina and West Van Buren Sts., awarded contract for the construction of a sports arena at Madison, Wood and Lincoln Sts. and Warren Ave. to J. W. Snyder & Co., 307 North Michigan Ave. Estimated cost $4,786,000.

Mass., Lynn—General Electric Co., 920 Western Ave., will build an addition to power house at River Works. Private plans. Work will be done by separate contracts.

Mass., Northampton — Cooley-Dickinson Hospital, awarded contract for the construction of a boiler house and central heating plant to M. I. O'Connor, 184 North Elm St.

Mass., Springfield—Street & Engineering Dept., City Hall, awarded contract for the construction of a pumping station to F. T. Ley & Co. Inc., 20 Providence, R. I.

N. J., Beachhaven—Bd. of Council, Boro Hall, will receive bids about Aug. 15 for an electric light plant. Estimated cost $50,000. W. H. Boardman, 426 Walnut St., Philadelphia, Pa., is engineer.

N. J., Newark—Majestic Holding Co., c/o W. Lehman, 972 Broad St., awarded contract for a 15 story hotel at Broad and Hill Sts. to W. J. MacEvoy Construction Co., 85 Academy St. Estimated cost $2,000,000. Steam heating system, etc. will be installed.

N. Y., New York—Colmed Realty Co., S. Silk, Pres., 475 5th Ave., will build a 12 story apartment building at 617 West 168th St., Estimated cost $1,000,000. R. H. Segal, 475 5th Ave., is architect. Work will be done by separate contracts.

N. Y., New York—S. Mayer, 41 East 72nd St., awarded contract for a 16 story apartment building at 200 East 68th St., to J. H. Taylor Construction Co., 31 Union Sq. Estimated cost $1,300,000.

N. Y., New York—New Amsterdam Casualty Co., J. A. Nelson, Pres., 60 John St., awarded contract for a 19 story office building at 56-60 John St. to James Stewart & Co., 17 East 42nd St. Estimated cost $1,000,000.

N. Y., New York—Racarulmer & Lehlbach, 420 Lexington Ave., Archts., will receive bids Aug. 1 for a community center at 92nd St. and Lexington Ave. for Young Men's Hebrew Assn., 148 East 92nd St. Estimated cost $1,300,000.

N. Y., New York—Teeson Construction Co., A. Tishman, Pres., 285 Madison Ave., will build an 11 story apartment building at 29 East 70th St. Estimated cost $3,000,000. Schwarz & Gross, 347 Fifth Ave., are architects.

N. Y., New York—Thirty-Five Forty-One Broad St. Corp., 43 Exchange Pl., awarded contract for the construction of a bank and office building at 35 Broad St. to G. A. Fuller Co., 949 Broadway. Estimated cost $1,500,000.

N. Y., Yonkers—Leeschest Building Co., J. Goldfob, Pres., 5 Getty Sq., plans the construction of a 22 story office building. Estimated cost $1,000,000. Warren & Wetmore, 16 East 47th St., New York, are architects.

O., Cleveland—Cleveland Electric Illuminating Co., 75 Public Sq. awarded contract for the construction of an electric substation at 1320 West 25th St. to Hunkin-Conkey Construction Co., Hunkin-Conkey Bldg. Estimated cost $90,000.

O., Cleveland—Cleveland Union Terminal Co., C. L. Bradley, Terminal Tower, will soon award contract for an 18 story medical office building, etc. on Ontario St. here. Estimated cost $5,000,000. Graham, Anderson, Probst & White, Railway Exchange Bldg., Chicago, Ill., are architects.

Okla., Oklahoma City—C. F. Colcord, Colcord Bldg., is having plans prepared for a 25 story hotel including steam heating system, etc. at Grand and Harvey Sts. Estimated cost $4,000,000. Hawk & Parr, Braniff Bldg., are architects.

Pa., Bloomsburg—Bloomsburg Hospital, will soon award contract for construction of a hospital, nurses home, boiler house, etc. Ballinger Co., Second and Chestnut St., Philadelphia, is architect.

Pa., Philadelphia—J. J. Greenberg, Morris Bldg., awarded contract for a 15 story bank and office building, etc. at 1608 Walnut St. to Wark Co., 1600 Walnut St.

Tex., Olney—Louisiana Power Co., Ft. Worth Club Bldg., is having plans prepared for the construction of a power plant here. Estimated cost $100,000.

Va., Arrington—Arrington Cold Storage Corp., plans the construction of a cold storage plant.

Wash., Seattle—Lighting Dept., will soon receive bids for the construction of a substation at Third and Madison Sts. Estimated cost $500,000.

Wis., Milwaukee—Wisconsin Cold Storage Co., 178 Florida St., awarded contract for the construction of an 8 story, 54 x 96 ft. cold storage warehouse to H. Schmitt & Son, 14 Burleigh St.

Ont., Oshawa — Oshawa Railways Co., H. W. Cooper, Mgr., Simcoe St. S., will soon award contract for the construction of a carbarn, stores building and sub-station. Estimated cost $150,000. J. Schofield, Canadian National Railway, James St., Montreal, Que., is architect. H. L. Vercoe, 1 Toronto St., Toronto, is engineer.

Equipment Wanted

Boiler—Radford Lumber Co., A. Meiselwood, Supt., Oshkosh, Wis., is in the market for a horizontal tubular boiler.

Coal Handling Equipment—London & Port Stanley Ry. Co., London, Ont., prices and catalogs on equipment for coal handling plant. Estimated cost $150,000.

Pump—Oshkosh Soap Co., R. M. Thiesses, Mgr., Oshkosh, Wis., is in the market for a boiler feedwater pump.

Pumping Equipment—City of Konawa, Okla., pumping equipment for proposed waterworks improvements. Estimated cost $150,000.

Pumps—City of Sentinel, Okla., plans to purchase centrifugal pumps for proposed waterworks improvements. Estimated cost $60,000.

Pumps and Motors—City of Maud, Okla., ten deep well pumps and motors for proposed waterworks improvements. Estimated cost $75,000.

Stokers, Etc.—Commissioner of Correction, 11 North Pearl St., Albany, N. Y., will receive bids until Aug. 16 for the installation of new mechanical stokers and replacing feed water heater, etc. at Sing Sing Prison, Ossining, N. Y.

Motors, Etc.—J. B. Preston Co., Inc., 345 Madison Ave., New York, N. Y., or Bowe-Burke Mining Co. will purchase one 15 hp. motor to propel long conveyor belt and one 5 hp. motor to operate pan feeder and conveyor belt, etc. for Emeralite Surfacing Co., Ely, Minn.

Pumping Equipment—Town of Newton, Sussex County, N. J., H. D. Masters, clk., will receive bids until Aug. 13 for pumping equipment, etc., for sewage treatment works at Sparta and Clinton Sts.

Refrigeration Equipment — Bureau of Yards & Docks, Navy Dept., Washington, D. C. refrigeration equipment for Naval Air Station, Pensacola, Fla.

Calif., Los Angeles — TALKING MACHINE FACTORY—Victor Talking Machine Co., c/o W. Knowles, 1214 Webster St., Oakland, Archt. is having plans prepared for the construction of a factory on Orange Dr. Estimated cost $250,000.

Calif., Richvale — PULP AND PAPER MILL—Pacific Coast Pulp & Paper Co., Los Angeles, C. A. Kieren, Clunie Hotel, Sacramento, Mgr., is having plans prepared for a 1, 2 and 3 story plant including 50 x 80 ft. boiler plant, etc. here. Estimated cost $1,000,000. P. Swan, Lewis Bldg., Portland, Ore., is engineer.

Calif., San Francisco—OIL BURNER FACTORY—W. S. Ray Mfg. Co., Bosworth and Milton Sts., manufacturers of Ray fuel oil burners, is having plans prepared for a 1 and 2 story addition to factory at Bosworth St. Estimated cost $70,000. Irvine and Ebbets, Call Bldg., are architects.

Ga., Cartersville — ORE WASHING PLANT—Georgia Manganese & Iron Co., Atlanta, plans the consctruction of a plant for hydraulic washing of ore here. Estimated cost $250,000. Perin & Marshall, 40 West 40th St., New York, are engineers.

Kan., Wichita—PACKING PLANT—F. Dold & Sons, 21st and Lawrence Sts., will soon receive bids for a 1 story, 100 x 180 ft. packing plant at 21st and Topeka Sts. Estimated cost $125,000. Herschen & McClaren, 1637 Prairie Ave., Chicago, Ill., are architects.

Ind., East Chicago—GYPSUM FACTORY—U. S. Gypsum Co., 300 West Adams St., Chicago, Ill., has acquired a site and plans the construction of a factory here.

Mich., Detroit—ALUMINUM FOUNDRY—Packard Motor Car Co., 1580 East Grand Blvd., awarded contract for addition to aluminum foundry to Everett Winters Co., 1651 East Grand Blvd. Estimated cost $100,000.

Mich., Ferndale (Br. Detroit)—TUB FACTORY—Steel & Tubes Inc., H. B. Wick, Pres., 224 East 131st St., Cleveland, O., is having plans prepared for first unit of factory, 1 story, 210 x 500 ft. Estimated cost $200,000. Sessions Engineering Co., 228 North La Salle St., Chicago, Ill., is engineer.

Mo., North Kansas City—REFINERY—Corn Products Refining Co., will build a 1 story refinery by day labor. Estimated cost $150,000.

Mo., St. Louis—FRUIT EXCHANGE—Wabash Railway Co., 1765 Railway Exchange Bldg., awarded contract for a 1 and 3 story, 56 x 640 and 82 x 140 ft. fruit exchange building at Second and Carr Sts. to Boaz-Keil Construction Co., Ambassador Theatre Bldg. Estimated cost $850,000.

N. J., Kearny—WAREHOUSE—Western Electric Co., M. Melin, 195 Broadway, New York, N. Y., is receiving bids for a 7 story warehouse on Central Ave. here. Estimated cost $1,200,000. Private plans.

O., Cincinnati—PAPER PLANT—Leschner Paper Co., Harrison and State Sts., awarded contract for a 2 story plant on State St. to Ferro Concrete Co., Elm St. Estimated cost $68,000.

O., Cleveland — AXLE AND SPRING FACTORY—Eaton Axle & Spring Co., C. I. Ochs, Pres. and Gen. Mgr., East 65th St., and Central Ave., had plans prepared for a 1 story, 120 x 340 ft. factory and 36 x 60 ft. boiler house on East 140th St. Estimated cost $175,000. G. S. Rider Co., Century Bldg., is architect.

R. I., Providence—TERMINAL—Produce Wholesale Food Terminal, c/o Jenks & Ballou, 1035 Grosvenor Bldg., Archts., will soon award contract for an 85 x 700 and 70 x 700 ft. terminal at Kinsley and Harris Aves. Estimated cost $3,000,000.

Wis., Milwaukee — FACTORY — International Harvester Co., W. B. Swift, Asst. Mgr., 606 South Michigan Ave., Chicago, Ill., will soon award contract for a 3 story, 108 x 302 ft. addition to factory on Park St. Private plans.

Ont., Sudbury—SMELTER PLANT—International Nickel Co., 67 Wall St., New York, N. Y., awarded contract for the construction of a nickel and copper smelter plant at Copper Cliff here to Fraser Brace Ltd, 83 Craig St. W., Montreal, Que. Estimated cost $1,000,000.